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ARITHMETICK

James Compendiz'd: Milne

Or, A ſhort

TREATISE

1757 OF Anno Domini

ARITHMETICK.

First compoſed for the Uſe of the Charity Schools, erected by the Society in *SCOTLAND* for propagating Christian Knowledge, eſtabliſhed by Her Royal Majeſty Queen ANNE, Her Letters Patents.

By a Member of the Society.

Now again publiſhed for a more general Benefit, with the Addition of ſome *Tables of Intereſt*, adapted to the various Rates eſtabliſhed by Law from Time to Time in *SCOTLAND*.

EDINBURGH:
Printed for Mr. *William Monro*, and ſold at his Shop, MDCCXXI.

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TO THE READER.

T*HE Title Page ſhews the Deſign of compoſing this* Short Treatiſe*; and nothing more is propoſed thereby, than ſo far to explain the common Parts of* Arithmetick, *in whole Numbers, and Fractions Vulgar and Decimal, as may fit thoſe for whom it is deſign'd for ordinary Buſineſs by a complete* Knowledge *of what is neceſſary for them of* Arith-

George Mylne

metick. *When any of them attain to ſuch* Knowledge *and Circumſtances as that their Affairs and* Genius *may lead them to look further into this uſeful* Science, *they may procure the Works of others, who have ſpent more Time and Pains than was thought needful for this. I do not pretend, and I believe no Body elſe, to write ſo fully and plainly on this Subject, as that the Beginner needs not the Help of a* Teacher, *but only to afford a ſmall plain Piece at a cheap Rate to ſerve for common Uſe; And yet however ſmall the preſent* Performance *is, it contains the firſt Grounds of* Arithmetick, *and ſo much as being well underſtood, will fit any for the Management of ordinary Affairs, either as a Merchant, Factor, Chamberlain, or Tradeſman, and is a good*

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Introduction to the Study of other more complete Works of this Kind.

I have endeavoured to explain all the Rules with as much Brevity and Plainneſs as poſſible, and have induſtriouſly kept out ſeveral Things which ſwell other Books on this Subject, ſuch as multiplicity of Examples *in each* Rule, *the* Rules *of* Fellowſhip, Allegation, Barter, Loſs *and* Gain, *&c. all which are only ſo many Branches of that excellent Rule commonly called the* Golden Rule, *or* Rule of Three. *I have alſo forborn to inſert many Tables to be found in other Books, and one Reaſon for my doing ſo is, That I never did ſee any truſt to ſuch Tables, becauſe of the Uncertainty of their being right printed; and have only to this new Impreſſion added two very uſeful* Tables *of* Intereſt, *which*

which I dare adventure to recommend as exact, and intirely free from Error, the ſame being accurately reviſed. I heartily wiſh, That all who undertake Buſineſs wherein Arithmetick *is needful, did but throughly underſtand what is herein, they would better acquit themſelves, and prevent many Inconveniencies and Loſſes that daily occur through Perſons undertaking Buſineſs which they are not able to manage through the Want of Knowledge in the common* Rules *and* Practice *of* Arithmetick.

George Mylne

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THE CONTENTS.

INTRODUCTION. Page 1

CHAPTERS.

1. Numeration. 3
2. Addition of Integers. 5
3. Addition of divers Denominations. 7
4. Subſtraction in Integers. 9
5. Subſtraction in divers Denominations. 11
6. Multiplication of Integers. 14
7. Multiplication of divers Denominations. 20
8. Diviſion of Integers. 23
9. Reduction. 35
10. The Golden Rule, or Rule of Three. 39
11. The Compound Rule of Three. 49

12. Vulgar Fractions. 55
13. Addition of Fractions. 61
14. Subſtraction in Fractions. 62
15. Multiplication of Fractions. 64
16. Diviſion of Fractions. 65
17. Decimal Arithmetick. 66
18. Reduction in Decimals. 68
19. Addition of Decimals. 73
20. Subſtraction in Decimals. 74
21. Multiplication in Decimals. 75
22. Diviſion in Decimals. 76
23. Appendix, with Tables of Intereſt. 81

George Wythe

ERRATA.

PAge 38. line 17. for 1440 *read* 1400. P. 43. line 6. for 3 : 1 : 26 *read* 3 : 12 : 6.

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ARITH-

ARITHMETICK

Compendiz'd.

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INTRODUCTION.

ARITHMETICK is the Art or Science, whereby we are taught rightly and dextrouſly to handle Numbers: And is ordinarly divided into three Kinds; two of which are called *Vulgar*, and the third *Decimal Arithmetick*.

As to the two *Vulgar Parts*; The firſt is called *Arithmetick* in whole Numbers; becauſe every Character in it repreſents an intire Quantity of ſome Species or Thing propoſed. The ſecond is called *Fractions*, which ſuppoſes an Unit, (or the Thing or Quantity repreſented) to be divided or broken into Parts.

As to the third Kind, to wit, *Decimal Arithmetick*; it is an artificial Invention for managing *Fractions* or *Broken* Numbers by an eaſy Way; In which the ſeveral Operations differ little from thoſe in whole Numbers.

The *Characters*, by which all Arithmetical Operations are performed, are theſe ten, *viz.*

1,	2,	3,	4,	5,	6,	7,	8,	9,	0.
One,	two,	three,	four,	five,	ſix,	ſeven,	eight,	nine,	Cypher.

The ſeveral Species or Kinds of Numbers are three, *viz. Digits*, *Articles*, and *Mixt Numbers.*

A *Digit* is any one of the firſt nine Characters or Figures above ſingly expreſt, as 1, 2, 3, *&c.*

An *Article* is any of the ſaid nine *Digits*, with a Cypher or Cyphers join'd to it on the right Hand, as

10,	30,	400,	*&c.*
Ten,	Thirty,	Four hundred,	

A *Mixt Number* is compoſed of ſeveral Digits; as

24,	17,	258,	*&c.*
Twenty four,	Seventeen,	Two hundred and fifty eight.	

Or it is compoſed of Digits and Cyphers intermixed, as

201,	310,	3020,	*&c.*
Two hundred and one,	Three hundred and ten,	Three thouſand and twenty.	

The principal Rules in Arithmetick are Five, *viz. Numeration*, *Addition*, *Subſtraction*, *Multiplication* and *Diviſion.* Of which in Order.

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CHAP. I.

Numeration.

NUMERATION teacheth, *Firſt*, To read or expreſs the Value of any Number when writ down. And *Secondly*, To write down any Number propoſed, according to its true Value.

In reading or writing down any Number, Two Things are to be obſerved. 1. The Place that any Digit poſſeſſeth. 2. The Value of each Digit in its Place. Both which are repreſented in the following Table.

Hundreds of Millions.	Tens of Millions.	Millions.	Hundreds of Thouſands.	Tens of Thouſands.	Thouſands.	Hundreds.	Tens.	Units.
9	8	7.	6	5	4.	3	2	5.
Third Period.			Second Period.			Firſt Period.		

By this Table it appears, That the Order of Places is reckoned from the right Hand towards the Left, each

Place exceeding the former ten Times. But the Order of reading is from the left Hand to the Right, and that in each Period there are three Figures.

The firſt Place is the Place of *Units*, ſo any Figure ſtanding in it repreſents ſo many Units, as 5 is Five. The ſecond Place is *Tens*, ſo any Figure ſtanding in it repreſents ſo many Tens, as 2 is twenty. The third Place is *Hundreds*, ſo any Figure in it repreſents ſo many Hundreds, as 3 is three hundred, *&c.* And ſo the preceeding Number in the Table is read thus, *viz. Nine hundred eighty ſeven Million, Six hundred fifty four thouſand, Three hundred and twenty five.*

5642. is read thus, Five thouſand, ſix hundred, forty two.

60235. is read thus, Sixty thouſand, two hundred thirty five.

230280. is read thus, Two hundred thirty thouſand, two hundred and eighty.

A ready Way in long Numbers, and for teaching Beginners to read and write them, is by pointing the Periods, thus,

Millions. Thouſands. Hundreds.

5 6 4, 8 3 7, 2 9 1. which is read thus, Five hundred ſixty four million, eight hundred thirty ſeven thouſand, two hundred, ninety one.

What is already taught on Nine Places in Numeration, being the fulleſt Extent needful for ordinary Practice, it is needleſs to inlarge any further on this firſt Rule or Part; which ought to be accurately taught, and clearly underſtood, before the Scholar proceed any further: It being often obſerved, That the not knowing Numeration perfectly, occaſions Difficulty in learning and practiſing the other Rules.

But to ſatisfy the curious Learner, here is one Example of more Places pointed as directed.

Millions of millions.
Hundred thouſands of millions.
Millions.
Thouſands.
Hundreds.

6, 4 2 9, 3 5 7, 4 6 1, 2 8 2. which is read thus, Six million of millions, four hundred twenty nine thouſand, three hundred fifty ſeven million, four hundred ſixty one thouſand, two hundred eighty two.

In which obſerve, That there are Two Periods in the Place of Millions (for, as is already ſaid, every Period has only Three Figures in it) and thus Numeration may be increaſed by repeating the Period of Millions as oft as needful, interjecting the Word *Of* ſo often as the Period is repeated.

CHAP. II.

Addition of Integers.

ADDITION is the gathering together of ſeveral Sums, that ſo their *Total* may be known. In which obſerve theſe *Two Rules*; Rule *Firſt*, To ſet down each Number in its due Order, ſo as each Figure may be under thoſe of the ſame Place, that is, *Units* under *Units*, *Tens* under *Tens*, *Hundreds* under *Hundreds*, &c.

Thus, ſuppoſe thoſe Numbers 2567, 483, 97, and 8, were given to be added together: Set them down thus,

2567	Or thus, for 'tis of	8
483	no Moment which	97
97	of the Sums be firſt	483
8	ſet down	2567
3155 Total		Total 3155

Rule *Second*, Draw a Line at the Foot, under which ſet down the *Total*. Beginning at the Place of *Units*, add together all the Figures in that *Column* upwards, and if their *Sum* be under Ten, ſet it down below the Line in its proper Place: But if their Sum exceed Ten, you muſt ſet down only the *Excreſcence* above Ten or Tens; and for each Ten in that Column, you muſt carry *One* to the next Column, which is Tens, adding what you carried, and all in the Column of Tens together, as you did in the Units, ſetting down the Excreſcence above Ten or Tens, and ſo on to each Place and Column till all is completed. But if in any Column there is nothing above Ten or Tens, then place a *Cypher* under that Column, and carry the Tens to the next as before directed.

Take this Example.

18654
9738
429
385
29206

Begin at the Place of *Units*, and ſay 5 and 9 is 14, and 8 is 22, and 4 is 26; ſet down 6 under Units, and carry 2 to the Place of Tens; *ſaying*, 2 I carried and 8 is 10, and 2 is 12, and 3 is 15, and 5 is 20. There being nothing over the Tens, ſet down 0 and carry 2 to the Place of Hundreds; *ſaying*, 2 I carried and 3 is 5, and 4 is 9, and 7 is 16, and 6 is 22, ſet down 2 and carry two to the next Place; *ſaying*, 2 I carried and 9 is 11, and 8 is 19, ſet down 9 and carry 1; which

35951

which being added to 1 in the laſt Column, makes 2, which ſet down, and the Work is finiſhed. So the *Total* of the Four Sums in the Example is, *Twenty nine thouſand two hundred and ſix.*

Examples for Practice.

78543	426	93572	4678
26725	321	4630	8245
42008	799	472	9554
70530	202	65340	256
14042	240	4785	379
21987	100	5246	78
65412	98	728	84
29078	72	282	987
10026	86	90	7
463	25	82	8
206	3	31	25
472	6	50	342
22	9	12	2183

CHAP. III.

Addition of Sums of divers Denominations, as of Money, Time, Weight, Meaſure, &c.

Rule. HAVING placed down the Numbers given to be added, in their due Order, obſerving to ſet each *Denomination* in one Column, under other, *viz.* *Pounds* under *Pounds*, *Shillings* under *Shillings*, *Pence* under *Pence*, &c. Conſider how many Units of the leaſt Denomination make an Unit of the next ſuperior Denomination, and how many Units you find of the higher Denomination contained in the Column of the lower Denomination, ſo many muſt you carry to the Column of the higher Denomination, and if there be any over, ſet down ſuch Overplus under its proper Column.

But this will be better underſtood by a Beginner, when he ſees it in Example. Suppoſe then the following *Sums of Money* were given to be added together; The Work will ſtand as below.

In this Example, as in all of the like Nature, obſerve, That every 12 Pence make 1 Shilling, and every 20 *ſh.* make 1 Pound; ſo here the Pence being added together, they amount to 26; which is twice 12 or 2 *ſh.* and 2 over; which 2 ſet down under the Line in the Place of Pence, and carry 2 to the *ſh.* which being all added make 44; which is twice 20 or 2 *lib.* and 4 over; which 4 ſet down in the Place of *ſh.* and two carried being joined with the Pounds, and the whole added, as is already taught in whole Numbers, the Total Sum is, 459 *lib.* 4 *ſh.* 2 *d.*

	lib.	*ſh.*	*d.*
	257	17	10
	138	12	2
	37	9	8
	25	4	6
Total	459	4	2

If the following Sums of *Weight* were given to be added, the Work will ſtand thus.

In this Example it is to be obſerved, That 16 *Drops* make 1 *Ounce*, 16 *Ounces* make 1 *Pound*, and 16 *Pounds* make 1 *Stone*. So the whole Sum is 45 *Stone*, 8 *Pound*, 11 *Ounce*, and 13 *Drops*.

	16	16	16
Stones.	*Pounds.*	*Ounces.*	*Drops.*
25	12	11	9
9	8	10	12
5	13	14	10
4	5	6	14
45	8	11	13

Examples for Practice.

lib.	*ſh.*	*d.*	*Years.*	*Months.*	*Weeks.*	*Days.*	*Stones.*	*Pounds.*	*Ounces.*
235	17	11	25	4	2	5	1	12	13
476	19	10	2	10	3	6	2	4	1
28	10	2	7	8	1	4	3	11	7
332	6	8	5	2	2	3	3	5	11
466	13	4	2	9	1	2	2	6	4
56	9	8	8	6	3	4	1	3	0
66	13	4	5	7	2	6	2	0	4
89	9	6	2	3	1	4	4	14	9
33	5	8	4	11	2	5	7	3	15

Nota. When in Addition of divers Denominations the Sums in one Column (as of Pence or Ounces, *&c.*) amount to a great Total, ſo that you cannot eaſily diſtinguiſh how many you are to carry to the next Column, it will be fit that you put a Point at a certain Period, as at each 60 in Pence, which makes 5 Shillings; or at each 80 in Ounces, which makes 5 Pounds, *&c.* which will make the Work very eaſy.

There is no certain Way to prove Addition, therefore 'tis adviſed, That in all Operations thereof the Practitioner try his Work twice or thrice over, ſometimes making the Addition upwards, and ſometimes downwards; for in ſo doing he will not readily fall twice into one and the ſame Miſtake.

CHAP. IV.

Subſtraction in Integers.

BY Subſtraction one Number is deducted from another, that ſo the *Remainder* or *Difference* may be known. As to ſubſtract 6 from 9, there will remain 3; This 3 is the Difference betwixt 9 and 6. Therefore in Subſtraction the leſſer Number is always to be ſet down below the greater, taking Care to place *Units* under *Units*, *Tens* under *Tens*, &c.

Rule. Having placed your Numbers as directed; Begin at the right Hand, or Place of Units, and ſubſtract the lower Figure in that Place, from the Figure which ſtands over it, ſetting down the *Remainder* or *Difference* below the Line, in its proper Place, doing the like through all the Places.

If the Two Figures happen to be equal, ſet down a Cypher.

If the upper Figure be leſs than the lower, then add Ten to the upper Figure, or in your Mind call it Ten more, borrowing it from the next Place, and from that Sum ſubſtract your lower Figure, ſetting down the Remainder as before directed. But becauſe you added Ten to the former Place, (which was borrowed from the next ſuperior Place) you muſt allow it back in that Place, by adding it to the lower Figure in that Place, when you come to ſubſtract there. All which will appear in the following Example.

	lib.
Borrowed by *A.* from *B.* ————	5842
Paid by *A.* to *B.* ————————	2751
Yet reſting by *A.* ———	3091

The Operation is thus. Begin at the right Hand, and ſay, 1 from 2, there remains 1, which ſet down. Next 5 from 4, I cannot but from 14 (borrowing 10 as was directed to make it 14) there remains 9. Then proceed, *ſaying*, 1 I borrowed and 7 is 8, from 8 remains nothing, for which place down a Cypher. Laſtly, 2 from 5, remains 3, which ſet down, and the Work is finiſhed.

Examples for Practice,

45926
19873

24865
4297

3570060
1902012

5347986000
1000490010

46002362
39420931

C H A P. V.

Subſtraction in Numbers of different Denominations.

IN this I ſhall give the Examples only in Pounds, Shillings and Pence, which to any thinking Perſon will be ſufficient to direct in all others of whatever Denominations.

In ſetting down the Numbers, take Care to place each Denomination in its proper Column, Pounds under Pounds, Shillings under Shillings, and Pence under Pence.

This done, begin at the Pence, then proceed to the Shillings, and laſtly to the Pounds, as in the following Example,

	lib.	*ſh.*	*d.*
Borrowed ——	235	14	8
Paid ——	129	11	4
Yet reſting ——	106	3	4

In working ſay, 4 from 8, remains 4 Pence. Next, 11 from 14, remains 3 Shilling, So proceed to the Pounds, *ſaying*, 9 from 15, remains 6; then 1 I borrowed and 2 is 3, from 3, remains 0. Laſtly, 1 from 2, remains 1. Which compleats the Work, and the whole Remainder is 106 *lib.* 3 *ſh.* 4 *d.*

But when it happens that the lower Number in the Pence or Shillings is greater than the Number above; you muſt, on ſuch Occaſion, borrow an Unit from the next ſuperior Denomination, as 1 *ſh.* which is 12 *d.* to ſupply the Place of Pence, and 1 *lib.* which is 20 *ſh.* to ſupply the Place of Shillings, remembring always to allow what you borrowed, when you come to the Place from whence you did borrow, as in the following Example.

	lib.	*ſh.*	*d.*
Borrowed ——	152	12	8
Paid ——	31	14	10
Yet reſting ——	120	17	10

In this Example ſay, 10 *d.* from 8 I cannot, but from 12 remains 2, which with the 8 makes 10 *d.* which ſet down. Then go to the *ſh.* *ſaying*, 1 I borrowed and 14 is 15 from 12, I cannot, bnt from 20, remains 5, which with the 12 makes 17, which ſet down. Then proceed to *lib.* *ſaying*, 1 I borrowed and 1 is 2, from 2 remains 0, and ſo forward through all the Pounds as formerly directed, and the whole Remainder will be 120 *lib.* 17 *ſh.* 10 *d.*

The following Examples are ſet down for the Learner's further Inſtruction and Practice, whereof ſome are finiſhed, the others to be wrought by himſelf.

	lib.	*ſh.*	*d.*	*lib.*	*ſh.*	*d.*
Borrowed	276	12	8	352	17	4
Paid	98	17	6	189	2	6

From

	Years.	Months.	Weeks.	Days.
From	25	8	2	5
Subſtract	12	9	1	3
Remains	12	11	1	2

Years.	Months.	Weeks.	Days.
4	5	1	2
1	8	2	3

	Stones.	Pounds.	Ounces.	Drops.
Borrowed	12	10	2	0
Paid	8	9	14	12
Remains	4	00	3	4

Stones.	Pounds.	Ounces.	Drops.
2	4	5	12
1	12	11	14

The *Proof* of Subſtraction is two Ways, 1. *Add* the Remainder to the leſſer Sum, and that Total will be juſt the greater Sum. Or, 2, *Subſtract* the Remainder from the greater Sum, and the Difference of thoſe will be juſt the leſſer Sum. As will appear thus.

	lib.	*ſh.*	*d.*
Borrowed	12	17	8
Paid	8	6	4
Reſting	4	11	4
Or from	12	17	8
Subſtract	4	11	4
Remains	8	6	4 which is the leſſer Sum.

	lib.	*ſh.*	*d.*
Now add	4	11	4
To	8	6	4
makes	12	17	8

which is the greateſt Sum.

CHAP. VI.

Multiplication of Integers.

BY Multiplication, we increaſe or multiply one Number by another, ſo as to produce their whole Amount. One Number is ſaid to be multiplied by another when a *Product* is found containing the Number multiplied, ſo oft as there are Units in the Number multiplying.

In Multiplication there are three Numbers or *Terms* to be obſerved.

1. The *Multiplicand*, or Number to be multiplied.

2. The *Multiplier*, or Number by which the Multiplication is made.

3. The *Product*, or Total proceeding from both. So if 15 be multiplied by 4, the Product will be 60.

The Operation is thus,

Multiplicand ——	15
Multiplier ——	4
Product ——	60

Thus you ſee the *Product* is 4 times the Multiplicand, as there are 4 Units in the Multiplier.

But before the Learner proceed in Multiplication, it is fit that he know the *Product* of any two *Digits* or ſingle Figures when multiplied together, elſe he will be ready to err in his Operation, therefore he is to get the following *Table* exactly by Heart.

The Table is very plain, and needs no Illuſtration, only let the Learner obſerve, That in the ſeveral Steps or *Periods* of the Table, the Number of Places decreaſes by 1, ſo that in the *Period* of 9, which is the laſt, there is but one Place, all other Multiplications of 9 being to be found in the preceeding *Periods*; for Example, 4 times 9 is 36, and ſo 9 times 4 is alſo 36, and ſo of all the reſt.

Table of MULTIPLICATION.

2 Times	2	is	4
	3	is	6
	4	is	8
	5	is	10
	6	is	12
	7	is	14
	8	is	16
	9	is	18
3 Times	3	is	9
	4	is	12
	5	is	15
	6	is	18
	7	is	21
	8	is	24
	9	is	27
4 Times	4	is	16
	5	is	20
	6	is	24
	7	is	28
	8	is	32
	9	is	36
5 Times	5	is	25
	6	is	30
	7	is	35
	8	is	40
	9	is	45
6 Times	6	is	36
	7	is	42
	8	is	48
	9	is	54
7 Times	7	is	49
	8	is	56
	9	is	63
8 Times	8	is	64
	9	is	72
9 Times	9	is	81

In Multiplication it is a Mattter indifferent which of the two Numbers is made the Multiplicand, and which the Multiplier, for the *Product* will be the ſame, yet in *Practice* it is moſt convenient to make the Number that has feweſt Places the Multiplier.

The Work of Multiplication is carried on from the right Hand to the Left, as in the former Rules. In which obſerve, at every particular Multiplication, to ſet down what is above Ten or Tens, and carry the

Tens to the next Place, and where there's no Exceſs, ſet down a Cypher.

Example, Multiply - - - 2563
by - - - 4
Product - - 10252

In this Example ſay 4 times 3 is 12, ſet down 2 and carry 1 to the next Place; *ſaying*, 4 times 6 is 24, and 1 I carried makes 25, ſet down 5 and carry 2. Then proceed, *ſaying*, 4 times 5 is 20, and 2 I carried is 22, ſet down 2 and carry 2. Then go forward, *ſaying*, 4 times 2 is 8, and 2 I carried is 10; which ſet wholly down becauſe the Work is ended.

Thus, you ſee the whole Figures in the Multiplicand are multiplied by the Multiplier: And the like is done by every Figure of the Multiplier when there is more than one: Obſerving this *Rule*, to ſet down the firſt Product of each Figure under the Figure by which you are multiplying, carrying the reſt forward to the left Hand, as you will ſee in the following Examples.

Multiply - - - 3247
by - - - 23
9741
6494
Product - - 74681

In this Example ſay, 3 times 7 is 21, ſet down 1 and carry 2; then 3 times 4 is 12, and 2 carried is 14, ſet down 4 and carry 1; then 3 times 2 is 6, and 1 carried is 7, which ſet down; then 3 times 3 is 9, which ſet down, ſo the firſt Part is ended. Then begin with the ſecond Figure of the Multiplier, *ſaying*, 2 times 7 is 14, ſet down 4 under the ſecond Figure of the Multiplier, and carry 1; then 2 times 4 is 8, and 1 carried is 9, which ſet down; then 2 times 2 is 4, which ſet down; and laſtly, 2 times 3 is 6, which ſet down; and the whole Multiplication is finiſhed.

After the Multiplication is thus finiſhed, add the ſeveral Products together, and the whole Product will be 74681 as in the Example.

Example 3. Multiply - - - 85321
by - - - - 243

255963
341284
170642

Product 20733003

I ſhall not trouble to work this Example as the other two: But only deſire the Learner to obſerve how the Products of each Figure in the Multiplier are advanced gradually, under the Figure by which the Multiplication is made.

The following Examples are ſet down for the Learner's Practice.

586732	576432
2679	794
5280588	2305728
4107124	5187888
3520392	4035024
1173464	457687008
1571855028	

Theſe and the other Examples, the Learner ought to practiſe on a ſeparate Paper, and compare how his Operation agrees with the Example.

Nota, In many Caſes the Work of Multiplication is abbreviate, *viz.*

1. When any Cyphers occur on the right Hand, either in the Multiplicand or Multiplier, or in both.

Rule. Multiply by the ſignificant Figures (obſerving the Directions already given) and then annex all the Cyphers on the right Hand of the Product, as in the following Examples.

Multiply - - 3600
by - - - 2300

108
72

Product - - 8280000

Multiply - - 5742
by - - - 250

28710
11484

Product 1435500

2. When Cyphers occur in the Multiplier in the Middle thereof.

Rule. Place the Product of the Figure next to the Cyphers towards the left Hand, ſo many Places forward as there are Cyphers, ſupplying the Places of the Cyphers with Points, and not make whole Lines of Cyphers (as ſome have done) as in the following Examples.

Multiply - - 3942300
by - - - 720020

78846
78846..
275961

Product 2838534846000

Multiply - - 345263
by - - - 402030

1035789
690526.
1381052.

Product 138806083890

3 When Cyphers occur in the Middle of the Multiplicand.

Rule. Set down the Figure which you was to carry from the former Multiplication, under the Place where the Cypher ſtands, and proceed to the next Figure, and if you have nothing to carry, then ſupply that Place with a Cypher; as you will ſee in the Examples following.

Multiply - - 4602
by - - - 39
41418
13806
Product 179478

Multiply - - 450032
by - - - 357
3150224
2250160
1350096
Product 160661424

Multiply - - 40020
by- - - - 20030
12006
84..
Product 9600600

4. When your Multiplier is 10, 100, 1000, *&c.* or any Article conſiſting of an Unit and Cyphers.

Rule. You have no more to do but add as many Cyphers to your Multiplicand as there are Cyphers in your Multiplier. Examples,

254 Multiplied by - - 10 is - - 2540.
437 Multiplied by - - 100 is - - 43700.
726 Multiplied by - - 1000 is - - 726000.

5. When your Multiplier is any other Article, that is, any Digit above an Unit with Cyphers annexed, as 20, 300, 4000, *&c.*

Rule. Multiply the Multiplicand by the Digit, and add to the Product thereof, all the Cyphers annexed thereto, as in the following Examples.

Multiply - -	354	42	212
by - - -	20	300	4000
Product - -	7080	12600	848000

CHAP. VII.

Multiplication of Numbers conſiſting of ſeveral Denominations, the Multiplier being an Integer.

Rule. BEGIN at the leaſt Denomination, multiplying by the Integer, and proceed gradually from the leaſt to the greateſt Denomination, carrying from the lower Denomination the Units belonging to the next greater Denomination, as in the following Example.

Multiply 7 *lib.* 13 *ſh.* 4 *d.* by 5. See the Work,

	7	13	4
			5
Product	38	6	8

The Operation is thus, Firſt 5 times 4 is 20 *d.* which is 1 *ſh.* 8 *d.* ſet down the 8 *d.* and carry 1 to the *ſh.* *ſaying*, 5 times 13 is 65 *ſh.* and 1 carried makes 66 *ſh.* which is 3 *lib.* and 6 *ſh.* ſet down 6 *ſh.* and carry 3 to the *lib.* *ſaying*, 5 times 7 is 35, and 3 carried makes 38, which ſet down, ſo you have the Product 38 *lib.* 6 *ſh.* 8 *d.*

If your Multiplier conſiſt of more Places than one, as 24, or 36, or 82, *&c.*

Rule. Multiply by ſuch two Numbers as being multiplied together will make the Number of your Multiplier. Example,

At 4 *lib.* 6 *ſh.* 8 *d.* the Ell, what will 24 Ells coſt? See the Work.

Here the firſt Multiplication is by 4, which produces 17 *lib.* 6 *ſh.* 8 *d.* and this Product multiplied by 6, the whole Product is 104 *lib.* as the full Anſwer to the Queſtion; for 4 times 6 is 24: So the two

4	6	8
		4
17	6	8
		6
104	00	0

Multiplications is equivalent to the multiplying by 24.

But in Caſe you cannot have two Numbers, which being multiplied together, will exactly make up the Multiplier; Then take the two Numbers that will come neareſt to it, and work as in the laſt Example: And for what is wanting, multiply the Number given by the Number wanting, and add the Products of all the Multiplications together, and ſo you have the Anſwer.

Example.

At 12 *lib.* 6 *ſh.* 8 *d.* the Boll, what will 78 Bolls coſt? See the Work.

	12	6	8
1. Multiply by - -			8
Product	98	13	4
2. Multiply by			9
Product	888	00	0
Add -			
Product of 12 : 6 : 8 multiplied by 6	74	00	0
Total Product - -	962	00	0

In the Example above, becauſe there are not two Numbers which when multiplied together will make 78; I take the two that come neareſt, *viz.* 8 and 9, which makes 72, and wants only 6. Then I multiply the Number given, firſt by 8, which makes 98 *lib.* 13 *ſh.* 4 *d.* and this Product I multiply by 9, which makes 888 *lib.* to which I add the Product of the Number given, multiplied by 6, being 74 *lib.* which makes in all 962 *lib.* as the full Anſwer.

The true Knowledge of this Rule will direct how to multiply any mixt Number, by any Number of Integers; by dividing your Multiplier into ſeveral Parts.

As for Example, At 12 *lib.* 6 *ſh.* 4 *d.* the Boll, what will 324 Bolls coſt.

See the Work.

Here multiply firſt by 9, the Product is 110 *lib.* 17 *ſh.* 0 *d.* which alſo multiplied by 9, makes 997 *lib.* 13 *ſh.* 0 *d.* which being multiplied by 4 makes 3990 *lib.* 12 *ſh.* 0 *d.* as the full Anſwer. For the firſt Number being multipliplied by 9, and that Product again by 9, is equal to multiplying by 81, becauſe 9 times 9 is 81. And that Product multiplied by 4 is equal to multiplying by 4 times 81, or 324, for 4 times 81 is 324.

12	6	4
		9
110	17	0
		9
997	13	0
		4
3990	12	0

If there be any broken Number in the Queſtion, as ſuppoſe, at 3 *lib.* 5 *ſh.* 6 *d.* the Boll, what will 9 Bolls and a half coſt?

Rule. Work firſt as directed in the foregoing Examples for the integer Bolls, and for the odd half Boll, add the Half of the Multiplicand.

See the Work, - - - at	3	5	6
what			9
Product - -	29	9	6
To which add the Half of 3 *l.* 5 *s.* 6 *d.* is	1	12	9
Total Anſwer - -	31	2	3

If the broken Number be three Quarters or one Quarter, &c. you are to add proportionally for the ſame.

Example, at 7 *lib.* 6 *ſh.* 8 *d.* the Boll, what will 8 Bolls and 3 Firlots coſt? *Nota*, The 3 Firlots is 3 Quarters of a Boll.

See the Work, - - at	7	6	8
what			8
Product - -	58	13	4
To which add 3 Quarters of 7 *l.* 6 *s.* 8 *d.* is	5	10	0
Total Anſwer - -	64	3	4

Or thus,

at - -	7	6	8
what			8
	58	13	4
Half a Boll	3	13	4
A Firlot - -	1	16	8
Total	64	3	4

The only ſure Proof of Multiplication is by Diviſion. Therefore I ſhall forbear treating upon it, until I have alſo taught the Rule of Diviſion, and iudeed it will then moſt naturally fall in: Becauſe, as Multiplication is proven by Diviſion, ſo Diviſion is proven by Multiplication: Any other Way being fallacious and uncertain, ſuch as throwing out the Nines, &c.

John

CHAP. VIII.

Diviſion in Integers.

DIVISION teacheth to diſcover, how oft one Number is contained in another.

In this Rule, there are three *Numbers* or Parts to be noticed, *viz.*

1. The *Dividend*, or Number to be divided.
2. The *Diviſor*, or Number by which the Diviſion is made.
3. The *Quotient* or Anſwer, which ſhews how oft the *Diviſor* is contained in the *Dividend*.

Sometimes alſo there is a 4th Number, which ariſes when the *Dividend* cannot be fully divided by the *Diviſor* into equal Parts; which is called the *Remainder*, and is always leſs than the *Diviſor*; as will afterwards appear.

In *Diviſion* 'tis to be obſerved, That as oft as an Unit is contained in the *Diviſor*, ſo oft does the *Dividend* contain the *Quotient* or Anſwer.

Diviſion is either *ſingle* or *compound*.

Single Diviſion is, when the *Diviſor* is one Figure or Digit, as 2, 4, 5, 7, 8, *&c.*

Compound Diviſion is, when the *Diviſor* conſiſts of two, three or more Figures, as 23, 352, 2685, *&c.*

Nota. In all Operations of *Diviſion*, the Courſe of the Work is from the left Hand to the Right; which is contrary to the preceeding Rules, which are wrought from the Right to the left Hand.

I ſhall begin with *ſingle Diviſion.* Suppoſe then 628 Pounds given to be divided amongſt 4 Men, what will each Man's Part be?

Rule. Place your *Dividend* betwixt two crooked Lines, thus) 628 (and ſet your *Diviſor* in the Line before the *Dividend*, leaving the other Line for your *Quotient*, and then proceed as follows.

Example 1.

Dividend Quotient or
Diviſor 4) 628 (157 Anſwer
 ∙∙∙
 4
 ——
 22
 20
 ——
 28
 28
 ——
 0

Firſt put a Point under 6, the firſt Figure of the Dividend, and ſay, how oft is 4 in 6 (*Anſwer*) 1, which place in the Quotient, ſaying once 4 is 4, which being ſet under and ſubſtracted from 6, remains 2; then point and bring down the next Figure 2, which will make 22, *ſaying*, 4 in 22 is 5 times, place 5 in your Quotient, *ſaying*, 5 times 4 is 20, which ſet under and ſubſtracted from 22, remains 2; then point and bring down 8, making 28, *ſay* 4 in 28 is 7 times, place 7 in the Quotient, *ſaying*, 7 times 4 is 28, which placed under and ſubſtracted from 28, there remains nothing; ſo the Work is finiſhed; and the Anſwer to the Queſtion ſtands in the Quotient 157: Which is as much as to ſay, that 628 *lib.* divided amongſt 4 Men, each one will get 157 *lib.*

If the firſt Figure of your Dividend be not greater, or at leaſt equal to your Diviſor, then you muſt take in another Figure, and put your firſt Point below it, for your firſt Dividend; as in this 2d Example,

In 1204 Days, how many Weeks. Here 1204 is to be divided by 7, becauſe there are 7 Days in one Week.

```
See the Work.   7) 1204 (172 Weeks.
                    . . .
                   7
                   --
                   50
                   49
                   --
                    14
                    14
                    --
                     0
```

In the preceeding Example, becauſe 7 the Diviſor cannot be had in 1, the firſt Figure of the Dividend, therefore the firſt Point is put under 2, the ſecond Figure of the Dividend. So you proceed thus, *ſaying*, 7 in 12 is 1, place 1 in the Quotient, *ſaying*, 1 time 7 is 7, which put under and ſubſtracted from 12, remains 5; then point and bring down 0, making 50, *ſay*, 7 in 50 is 7 times, place 7 in the Quotient, *ſaying*, 7 times 7 is 49, which ſet under and ſubſtracted from 50, there remains 1. Laſtly, Point and bring down 4, making 14, *ſay* 7 in 14 is 2 times, ſet two in the Quotient, *ſaying* 2 times 7 is 14, which ſet under and ſubſtracted from 14, remains nothing. So the Work is ended. And the Anſwer is, that in 1204 Days are 172 Weeks.

Nota. The pointing of the Figures in the Dividend, is of two Uſes; 1. To ſhow how far you have proceeded in your Work. 2. To ſhow how many Figures ought to be in the Quotient. For as many Points as there are in the Dividend, ſo many Figures muſt there be in the Quotient; as is evident in the Examples.

If at any Time, in the Middle of an Operation, it happen that the former Remainder and Figure pointed and brought down is leſs than the Diviſor, you muſt place a Cypher in the Quotient, and point and bring down another Figure, and ſo oft as thus there is a Defect, as oft muſt you place a Cypher in the Quotient; And if there be ſuch a Defect after bringing down the laſt Figure of your Dividend, then place a Cypher in your Quotient, and the Operation is ended.

Example 3. Suppoſe 1050700 given to be divided by 35.

See the Work.

```
35) 1050700 (30020
      .....
    105
    ----
    0070
      70
    ----
      00
```

In this Example, becauſe 35 cannot be found in the firſt two Figures of the Dividend, therefore the firſt Point muſt be under the third Figure; and the firſt Operation is, how oft 35 is to be found in 105. But this, and the like, where there are many Figures, being uneaſy and impracticable for the Memory; therefore, the beſt Way is, to try how oft the firſt Figure of the Diviſor, is contain'd in the firſt of the Dividend, and then to proceed; With this Caution, That in Caſe the ſecond Part or Figure of the Diviſor, cannot alſo be found as oft in the ſecond Figure of the Dividend, when join'd to the Remainder of the firſt Figure (if any be) then you are to take your Quotient Figure one leſs than before. And it will often occur, that though you can find the 1 and 2 Figures of your Diviſor and Dividend, to anſwer to your Quotient Figure, which you firſt found, yet you will find the third, and ſometimes the fourth to be defective, therefore, according to the Greatneſs of your Diviſor, you muſt, by your Memory, try the Figure of your Quotient, through the firſt, ſecond and third, and ſometimes the fourth Figures of your Dividend, before you proceed to Work; but generally a Trial in three Figures will be ſufficient: Which will partly appear in the next Example.

Now as to the preceeding Example the Operation is thus. Firſt ſay how oft 3 in 10, is 3 times, ſet 3 in the Quotient, by which multiplying the Diviſor 35, ſetting the Product below, and ſubſtracting it from 105, the firſt Point of your Dividend, there remains nothing or 0, to which point and bring down 0, and becauſe the Diviſor cannot be found therein, therefore put 0 in the Quotient; then point and bring down 7, and becauſe the Diviſor cannot be found therein, therefore put another 0 in the Quotient; then point and bring down 0, then ask how oft 3 in 7, is 2 times, place 2 in the Quotient, by which multiplying your Diviſor and ſetting the Product below, and ſubſtracting it from 70, there remains 0. Laſtly, Point and bring 0, and becauſe your Diviſor is not to be found therein, put 0 in the Quotient, and the Work is ended. And the Anſwer is 30020.

Example 4. Let it be required to divide 123156 by 36.

See the Work.

```
36) 123156 (3421
      . :::
    108
    ---
     151
     144
     ---
       75
       72
       --
        36
        36
        --
         0
```

In this Example, altho' 3 the firſt Figure of the Diviſor be 4 times in the firſt Part of the Dividend, yet you will not find 4 times 6 in 3, therefore you muſt take 3 for your Quotient Figure, by which having multiplied 36, and ſet the Product under, and ſubſtracted it from 123, the firſt Point of the Dividend, there remains 15; then point and bring down 1, makes 151; then try how oft 3 is in 15, and you will find it can be only 4 times, ſet 4 in the Quotient, then multiply the Diviſor and ſubſtract as formerly, there will remain 7; then point and bring down 5, makes 75;

aſk how oft 3 in 7 you will find it 2 times, ſet 2 in the Quotient, by which multiply the Diviſor, and ſet the Product under and ſubſtract it from 75, there remains 3; Laſtly point and bring down 6, makes 36, which being equal to the Diviſor, ſet 1 in the Quotient, and nothing remains, ſo the Work is ended, and the Anſwer is 3421.

Example 5. By three Figures. Let it be required to divide 379302 by 231.

See the Work,

```
231) 379302 (1642
     ....
     231
     ----
     1483
     1386
     -----
      970
      924
      ----
       462
       462
       ----
         0
```

The Manner of working this Example being the ſame as in the former, I ſhall forbear to explain the ſame.

Let the Learner ſtudy the Knowledge of the preceeding Examples. By 1, 2 and 3 Figures in the Diviſor, and he will underſtand how to work by any Number of Figures.

If any *Remainder* happen to be after your Diviſion is finiſhed; that Remainder is the *Numerator* of a *Fraction*, and the Diviſor is the *Denominator*, the Value whereof is to be diſcovered, as in the following Example.

Example 6th.

Let it be required to divide 368424 *lib.* amongſt 1728 Men, that each Ones Share may be known in *lib. ſh. d.*

See the Work. *lib.* *ſh.* *d.*
1728) 368424 (213 4 2
3456
2282
1728
5544
5184
360 Remainder is $\frac{360}{1728}$
ſh. in a *lib.* 20
1728) 7200 (4 *ſh.*
6912
288 Remainder.
d. in a *ſh.* 12
576
288
1728) 3456 (2 *d.*
3456
0

After you have finiſhed your Diviſion and found the Quotient of 213 *lib.* there is a Remainder of 360 *lib.* which is $\frac{360}{1728}$ Parts of a *lib.* for finding the Value whereof in *ſh.* and *d.* firſt multiply this Remainder 360 by 20, produces 7200 *ſh.* which divided by the firſt Diviſor 1728, you will find 4 *ſh.* which place in your Quotient in the Place of *ſh.* and there is a Remainder of 288 *ſh.* which multiplied by 12, produces 3456 *d.* which being divided by your firſt Diviſor, you will find 2 *d.* and nothing remaining, ſet down 2 in your Quotient in the Place of *d.* and the Work is ended, and the Anſwer is 213 *lib.* 4 *ſh.* 2 *d.* to each Man.

If there had been any Remainder in the *d.* it would have been the Fraction of 1 *d.*

The Nature of a Fraction will be explain'd when we come to treat of Fractions.

Becauſe the Work of Diviſion proves uneaſy to Beginners, for when the Diviſor conſiſts of many Places,

the

he is often uncertain what Figure to put in the Quotient. As a Help in this, let him make a Table of the Diviſor multiplied by the Nine Digits, in which he will find the Quotient Figure and its Multiplication for every Dividual.

Example.

Let it be required to divide 1460862 by 234.

Table of the Diviſor by the Nine Digits.

1 - - -	234
2 - - -	468
3 - - -	702
4 - - -	935
5 - - -	1170
6 - - -	1404
7 - - -	1638
8 - - -	1872
9 - - -	2106

2311
1168
702
97 6 1638
3
1

```
234) 1460862 (6243
        ...
     1404
     ----
       568
       468
       ----
       1006
        936
        ----
         702
         702
         ---
           0
```

In the Example above, the firſt Dividual is 1460, the Number in the Table neareſt to it and leſs is 1404, which ſtands againſt 6; place 6 in the Quotient, and ſet down 1404 under the Dividual, and ſubſtract as formerly directed, ſo there remains 56; to which point and bring down 8, making 568 for the next Dividual; the Number in the Table neareſt to it is 468, and ſtands againſt 2, place 2 in the Quotient, and ſet down 468, and ſubſtract as formerly, there remains 100; to which point and bring down 6, making 1006, for the next Dividual: The Number neareſt it is 936, ſtanding againſt 4; place 4 in the Quotient, and ſet down 936, and ſubſtract as before, there remains 70; to which point and bring down 2, making 702 for the laſt Dividual; the Number anſwering to it is juſt 702, and ſtands againſt 3, place 3 in the Quotient, and ſet down 702. So the Work is ended, and there is no Remainder.

Nota. In conſulting your Table, be ſure never to take a Number higher than your Dividual.

2
3
4
5

Contractions in Diviſion.

1. IF your Diviſor be one of the Nine Digits ſingly, as 2, 3, 4, 5, *&c.*

Rule. You need only take the Half, Third, Fourth, Fifth, *&c.* Part of the Number given, as in the following Examples.

Divide 7642 by 2.
One Half is 3821 Quotient.

Which is performed thus; beginning at the left Hand, *ſay*, the Half of 7 is 3, which ſet down, and 1 remaining join'd to 6 makes 16, the Half whereof is 8, which ſet down; next, the Half of 4 is 2, which ſet down; laſtly, the Half of 2 is 1, which ſet down; ſo your Quotient or Anſwer is 3821.

Divide 7426 by 3.
One Third is $2475\frac{1}{3}$ Quotient.

Perform'd thus, One third of 7 is 2, One third of 14 is 4, One third of 22 is 7, and One third of 16 is 5, and there remains 1, which is $\frac{1}{3}$.

Divide 67453 by 5.
$13490\frac{3}{5}$ Quotient

Perform'd thus, One fifth of 6 is 1, One fifth of 17 is 3, One fifth of 24 is 4, One fifth of 45 is 9; and laſtly, One fifth of 3 is 0; ſo there remains 3, which is $\frac{3}{5}$.

Theſe three Examples duly conſidered, are ſufficient to direct in all others.

2. If your Diviſor be an Unit, having Cyphers on the right Hand.

Rule. Cut off from the right Hand in your Dividend ſo many Figures as there are Cyphers in your Diviſor, and the Figures cut off on the right Hand are the Remainder.

Suppoſe then 46575 *lib.* were given to be divided amongſt 10, or 100, or 1000 Perſons, the Anſwers will be as follows.

Firſt, If among 10; the Anſwer is 4657 *lib.* 10 *ſh.* to each, thus - - - - - 4657|5. The 5 cut off is $\frac{5}{10}$ or 10 *ſh.*

Secondly, If among 100, the Anſwer is 465 *lib.* 15 *ſh.* to each, thus - - - - 465|75. The 75 cut off is $\frac{75}{100}$ or 15 *ſh.*

Thirdly, If among 1000. the Anſwer is 46 *lib.* 11 *ſh.* 6 *d.* to each, thus - - - 46|575 The 575 cut off is $\frac{575}{1000}$ or 11 *ſh.* 6 *d.*

The Value of the above Remainders or Fractions is found by the Rule in the 6th Example.

3. If your Diviſor and Dividend have each of them Cyphers on the right Hand.

Rule. Cut off an equal Number of Cyphers in both, and proceed to Work with the remaining Figures.

So if 7652000 were to be divided by 26000; Having cut off 3 Cyphers in each, there will remain 7652, to be divided by 26.

4. If your Diviſor have Cyphers on the right Hand, and that there is none in the Dividend.

Rule. Cut off ſo many Figures in the Dividend, as there are Cyphers in the Diviſor, cutting off alſo the Cyphers from the Diviſor, and proceed in your Work with the Remainders, with this Caution, That you add the Figures cut off in the Dividend to the Remainder, after your Work is ended, which will be a Numerator to your whole Diviſor, as in the following Example.

Suppoſe 367842 *lib.* given to be divided amongſt 2200 Perſons.

See the Work.

22|00) 3678|42 (167$\frac{442}{2200}$

.:.

22

147
132

158
154

Remains - - 4 to which join 42 cut off, makes 442 as the Numerator to the Diviſor 2200; ſo the Quotient as above is 167$\frac{442}{2200}$, the Value of which Fraction you may find by the Directions in the 6. Example.

5. If your Diviſor be any of the Digits above an Unit, with Cyphers annexed, as 20, 200, 30, 300, 4000, 50000, *&c.*

Rule. Cut off ſo many Figures from the right Hand of your Dividend, as there are Cyphers cut off in your Diviſor, and divide the Remainder by the Digit, according to the Directions in the firſt Rule of Contractions.

Example. Divide - - 2485000 by 200.
The Work is thus, - 2|00) 24850|00
One Half is 12425 the Anſwer.

Divide 53426 by 400, the Work will be
thus - - 4|00) 534|26.
One Fourth is 133$\frac{226}{400}$ the Anſwer.

Divide 8976432 by 6000, the Work will be
thus - - 6|000) 8976|432
One Sixth is - 1496$\frac{432}{6000}$ the Anſwer.

In theſe Examples obſerve, That the Remainders are ſet as Numerators to the whole Diviſor, the Value whereof is diſcovered by the Directions in the 6th Example.

Proof of Multiplication and Diviſion.

AT the End of Multiplication I advertiſed the Learner, That Multiplication and Diviſion did mutually prove each other.

1. For Multiplication. Divide your Product by your Multiplier, the Quotient will be your Multiplicand exactly.

2. For Diviſion. Multiply your Quotient by your Diviſor, the Product will be your Dividend exactly.

Example for both.

```
Multiply  - -  41725
by  : - - -      632
          ----------
               83450
              125175
             250350                  Proof of Multi-
    632)     26370200     (41725     plication.
               .....         632
             2528        ---------
            ------           83450
              1090          125175
               632         250350
            ------         ---------
              4582         26370200  Proof of Di-
              4424                   viſion.
             -------
               1580
               1264
             -------
               3160
               3160
             -------
                  0
```

In the Example above, the Product of the Multiplication which is 26370200 being divided by the Multiplier 632, the Quotient produces 41725 which is the Multiplicand, which proves the Work of Multiplication.

Next. The Quotient 41725 being multiplied by 632 the Diviſor, the Product is the ſame with the Dividend, to wit 26370200; which proves the Work of Diviſion.

CHAP. IX.

REDUCTION.

REDUCTION is the Rule whereby Sums are changed from one Denomination to another, whether higher or lower. As *lib.* into *ſh.* or *d.* Or *ſh.* or *d.* into *lib.*

So *Reduction* is of two Kinds, *Aſcending* or *Deſcending.*

Reduction aſcending is, when we are to reduce a Number of a leſſer Denomination to a Number of a higher Denomination, as *d.* or *ſh.* into *lib.* which is done by *Diviſion.*

Rule. Divide the Number given, by ſuch a Number of Units of the Denomination given, as make an Unit of the ſuperior Denomination, and the Quotient is the Anſwer.

Example 1. Reduce 1728 *d.* into *ſh.*

See the Work.

```
12) 1728 (144 ſh.
    12
    ——
     52
     48
     ——
      48
      48
      ——
       0
```

Here the *d.* given are divided by 12, becauſe 12 *d.* make 1 *ſh.* and the Quotient is 144; which ſhows that 1728 *d.* is equal to 144 *ſh.*

If the Reduction be two (or more) Steps as Reduction of *d.* into *lib.*

Rule. Make your Operation gradually to each Denomination, till you come to the higheſt

Example 2. Reduce 29280 *d.* into *lib.*

See the Work.

```
12) 29280    (2440 ſh.
    24
    ——
     52    2|0)244|0
     48      ½ is 122 lib.
     ——
      48
      48
      ———
      00
```

Here the firſt Diviſion is by 12, which produces 2440 *ſh.* which being divided by 20 (becauſe 20 *ſh.* make 1 *lib.*) produces 122 *lib.* for the Anſwer.

If in an Operation of this Kind there happen a Remainder in any of the Diviſions, ſuch Remainder is of the ſame Denomination with the Sum divided.

Example 3. In 1996 *d.* how many *lib. ſh.* and *d.*

See the Work.

Here the ſeveral Diviſions being made, the Anſwer is 8 *lib.* 6 *ſh.* 4 *d.*

```
12)  1996  (16|6 ſh.
     ...    ——
     12     ½ - 8 lib.
    ————
     79
     72
    —————
      76
      72
     —————
Remains - - 4  d.
```

Reduction deſcending is, when we bring a Sum of a greater Denomination, into a Sum of a leſſer Denomination: As *lib.* into *ſh.* or *d.* *&c.* which is performed by Multiplication.

Rule. Multiply the Number given, by ſuch a Number of Units of the inferior Denomination, as make an Unit of the higher Denomination, and the Product is your Anſwer.

Example 1. In 224 *lib.* how many *ſh.*?

See the Work.

Here you multiply the Number given by 20, (becauſe 20 *ſh.* make 1 *lib.*) and the Product is 4480 *ſh.* for your Anſwer.

```
 224
  20
————
4480
```

When the Reduction has two (or more) Steps, as reducing *lib.* to *d.*

Rule. Make your Operation gradually to each Step till you come to the loweſt.

Example 2. In 1352 *lib.* how many *d.*?

See the Work,

Here you firſt reduce the *lib.* to *ſh.* by multiplying by 20, ſo you have 27040 *ſh.* Then you reduce thoſe *ſh.* to *d.* by multiplying by 12, ſo the laſt Product is 324480. Which is the Number of *d.* in 1352 *lib.*

1352
20
―――
27040 *ſh.*
12
―――
5408
2704
―――
324480 *d.*

Theſe Examples and Directions, when duly conſidered, are ſufficient to illuſtrate the Rule of Reduction. But for the Learner's Inſtruction I ſhall ſubjoin a few Examples which the Learner may work himſelf.

In 245 Days how many Hours? Anſwer 5880. Found by multiplying by 24, which is the Number of Hours in one Day.

In 350 Bolls how many Firlots? Anſwer 1440. Found by multiplying by 4, which is the Number of Firlots in one Boll.

In 23 Years, how many Months, Weeks or Days? Anſwer 276 Months, or 1104 Weeks, or 7728 Days, Found by multiplying firſt by 12 for Months, then that Product by 4 for Weeks, and the laſt Product by 7 for Days.

In 5880 Inches how many Ells? Anſwer 163 Ells and 12 Inches. Found by dividing by 36, which is the Number of Inches in one Ell.

In 19230 Pence, how many Shillings or Pounds? Anſwer, 1602 *ſh.* and 6 *d.* or 80 *lib.* 2 *ſh.* 6 *d.* Found by Diviſion.

CHAP. X.

The Rule of Three, or Golden Rule.

THIS Rule is called the *Golden Rule,* becauſe of its extraordinary Uſefulneſs, in all Arithmetical Queſtions and Operations.

It is alſo called the *Rule of Proportion,* becauſe, from certain Numbers given and known, another unknown and ſought, is found out.

This *Rule* is either *Single* or *Compound.*

The *Single Rule of Three* is, when three Numbers are given, and a fourth proportional to them is ſought.

The *Compound Rule of Three* is, when five Numbers are given, and a ſixth proportional to them is ſought.

As to the *Single Rule,* Obſerve, firſt, That ſome Queſtions are reſolved by multiplying the ſecond Number by the third, and dividing that Product by the firſt Number, and the Quotient is the Anſwer, which is called the Direct Rule. Other Queſtions are reſolved by multiplying the ſecond Number by the firſt, and dividing the Product by the third Number, which is called the *Indirect Rule.*

The firſt Thing to be noticed, is, the right ſtating of the Numbers given; for doing whereof, obſerve this.

Rule. Suppoſe this to be the Queſtion, If 4 Students ſpend 19 *lib.* what will 8 Students ſpend? The Number upon which the Queſtion is raiſed, muſt ſtand in the third Place, and the other which is of the ſame Denomination, muſt be in the firſt, and conſequently, the other Number of a different Denomination muſt poſſeſs the Middle Place.

As

	Stud.	*lib.*	*Stud.*
As follows, if - -	4	19	8

The firſt and third Numbers are called the Extremes, and the Middle Number the Mean.

In which Queſtion, a fourth Number is ſought, which muſt bear ſuch Proportion to the ſecond, as the third doth to the firſt. That is, as 8 is double 4, ſo the Number ſought muſt be double 19. For if 4 Students ſpend 19 *lib.* 8 Students will ſpend twice 19 *lib.*

See the Work.

Here according to the Directions given, 19 the Middle Number, being multiplied by 8 the third Number, produces 152, which being divided by 4 the firſt Number, the Quotient is 38, which is the Anſwer; and ſo is ſet down as the fourth Number required.

ſt. *lib.* *ſt.* *lib.*
4 19 8 38
8 *lib.*
4)152 (38 Anſwer.
. .
12
32
32
0

Which completes the Propoſition, and anſwers the Queſtion.

Example. Of the Indirect Rule.

If a certain Quantity of Hay maintain 8 Horſe for 12 Days, how long will the ſame Quantity maintain 1 Horſes?

Here as 8 is to 16, ſo is 12 to the Number ſough And therefore as 8 is the Half of 16, ſo the Number ſought will be the Half of 12.

See the Work.

8 12 16 6
8 Days.
16) 96 (6 Anſwer.
96
0

In this Example the ſecond Number multiplied by the firſt, produces 96, which being divided by the third Number, the Quotient is 6 for the Anſwe of the Queſtion, and is ſet down in the fourth Place: So if 8

Horſes be maintain'd 12 Days by a certain Quantity of Hay; the ſame Quantity will maintain 16 Horſes only 6 Days.

The two preceeding Queſtions being very plain, and their Reſolution very natural, even without Skill in Arithmetick; The Rules are thereby clearly illuſtrated.

But becauſe there is great Variety of Queſtions that are reſolved by the *Rule of Three*, yea infinite Variety; and that all Learners are difficulted to diſcover, whether the Operation be by the direct or indirect Rule; To make this eaſy, obſerve this.

Rule. Conſider whether the Number you are ſeeking be greater or leſs than the Middle Number, (which will be obvious to a very mean Capacity) and if it be greater, then the leſſer Extreme is the Diviſor. If it be leſs than the Middle Number, then the greater Extreme is the Diviſor. And having found which of the two Extremes is the Diviſor, it will appear whether the Operation is by the direct or indirect Rule.

Example of the Direct Rule.

If 13 Packs of Cloth coſt 326 *lib.* what will 39 Packs coſt.

See the Work.

```
      13 : 326 : : 39 : 978
               39
              ----
              2934
              978
             ------ Pounds.
         13) 12714 (978  Anſwer.
              117
             -----
              101
               91
             -----
              104
              104
             -----
                0
```

Which is ſet down as the fourth Number.

Example of the Indirect Rule.

If 55 Maſons build a Houſe in 15 Months, how ſoon would 165 Maſons build it.

See the Work.

55 : 15 : : 165 : 5

55

75

75

Months,

165) 825 (5 Anſwer.

825

0

In Caſe any of the Numbers given be of divers Denominations, you muſt reduce the ſame to the loweſt Denomination. As Pounds, Shillings and Pence muſt be reduced to Pence; Years, Months and Weeks muſt be reduced to Weeks, &c.

Obſerving. That if any one of the two Extremes be reduced, the other Extreme muſt alſo be reduced alike with it.

And if the Middle Number be reduced, you are to notice, That the Anſwer will be in the ſame Denomination, to which your Middle Number is reduced. A which will appear in the Examples following.

If 64 Ells of Stuff coſt 38 *lib.* 8 *ſh.* what will 5 Ell coſt.

See the Work.

lib. *ſh.*

38 : 8

20

makes 768 *ſh.*

64 : 768 : : 5 : 60

5

64) 3840 (60 *ſh.*

384

00

In the Queſtion above, the Middle Number is reduced to *ſh.* ſo the Anſwer is 60 *ſh.*

If 6 Ells of Stuff coſt 3 *lib.* 12 *ſh.* 6 *d.* what will 64 Ells and a Quarter coſt?

Before you ſtate your Queſtion, you muſt reduce your firſt and third Numbers to Quarters; and your Middle Number to *d.* which is thus,

6	3 : 1 : 26	64 $\frac{1}{4}$
4	20	4
24 Quarters	72	257 Quarters.
	12	
	150	
	72	
	870 *d.*	

Then your Queſtion will ſtand as follows.

Quarters. Pence. Quarters.
24 : 870 :: 257 : 9316 $\frac{6}{24}$ *d.*

257
609
435
174
24) 223590 (9316 $\frac{6}{24}$ *d.*
....
216
75
72
39
24
150
144
6

Anſwer. Which being reduced according to the Rule of Reduction, amounts to 38 *lib.* 16 *ſh.* 4 $\frac{1}{4}$ *d.*

If 52 Ells 3 Quarters of 6 Quarter broad Stuff hang a Room, how many Ells of Ell broad Stuff will hang the ſame Room?

Here the Queſtion ariſes upon the Breadth of the Stuff.

See the Operation.

6 : 52$\frac{3}{4}$: : 4 : 79$\frac{1}{8}$ Ells.
4
211 Quarters.
6
4) 1266 (316$\frac{2}{4}$ Quarters; which reduced to Ells, makes 79 Ells and $\frac{1}{2}$ as the Anſwer.
. . .
12
06
4
26
24
2

If a Servant's Weekly Pay be 3 *lib.* 4 *ſh.* and is forborn for 2 Years 6 Months and 3 Weeks, what will then be due to him?

See the Work.

3 *lib.* 4 *ſh.* 2 Y. 6 Mo. 3 Weeks.
20 12
64 *ſh.* 30 Months.
4
123 Weeks.

Then ſtate the Queſt. thu
W. *ſh.* *W.*
1 ; 64 : 123
64
492
738
Anſwer 787|2 *ſh.*
Which is 393 *l.* 12 *s.*

Here the Weekly Pay is reduced to *ſh.* ſo the Anſwer is in *ſh.* which being again reduced makes 393 *l.* 12 *s.* and the Years, Months and Weeks are all reduced to Weeks. As in the Operations above.

If for 4 Weeks or 28 Days Diet I pay 14 *lib.* 13 *ſh.* 4 *d.* what muſt I pay for a Year, which is 365 Days?

See the Work.

lib. *ſh.* *d.* *lib.* *ſh.* *d.*
28 : 14 : 13 : 4 :: 365 : 191 : 3 : 9 $\frac{20}{28}$
20
293
12
590
293
3520 *d.*
365
1760
2112
1056
28) 1284800 (45885 $\frac{20}{28}$ *d.* Which being reduced, makes for the Anſwer 191 *lib.* 3 *ſh.* 9 $\frac{20}{28}$ *d.*
. . . . .
112
164
140
248
224
240
224
160
140
Remains 20

If 360 Men be in Garriſon, and have Proviſion for 6 Months, but knowing of no additional Proviſion for 9 Months, how many Men muſt be turned out, that the Proviſion may laſt the whole 9 Months?

The Queſtion is thus, - - - 6 : 360 :: 9 : 240
6
9) 2160 (240 Men.
. . .
18
36
36
00

Here the Anſwer is 240 Men to be kept in Garriſon, and the reſt of the 360, to wit, 120 Men are to be put out.

Nota. It will often occur in Queſtions of this Rule, that there muſt be ſome previous Preparation, before you can ſtate the Queſtion for Operation, as will appear in the following Examples.

A Merchant buys 64 Tuns of Wine for 460 *lib. Sterling*, on which he pays the following Charges, *viz.* 220 *lib.* for Fraight. 10 *lib.* for Loading and Unloading. 15 *lib.* for Cuſtom, and 8 *lib.* of Cellar Rent. He deſigns to ſell the Wine at ſuch Rate as to gain 250 *lib.* on the Bargain. A Gentleman offers to buy 24 Tuns of the Wine; The Queſtion is, what he muſt get for the 24 Tuns?

The previous Preparation is to ſum up the whole Charge and Coſt of the Wine, adding thereto the Profit deſired. Thus,

	lib.
Firſt Coſt - -	460
Fraight - - -	220
Loading, &c. - -	10
Cuſtom - - -	15
Cellar Rent - -	8
Profit - - -	250
Total - -	963

Then ſay

```
64 : 963 :: 24 :
       24
     ----
     3852
     1926     lib.  ſh.  d.
    -----
64) 23112 (361    2    6
    ...
    192     The Anſwer
    ---     for the Price
     391    of 24 Tuns.
     384
     ---
      72
      64
      --
Remains 8   Which being reduced, is 2 ſh. 6 d.
```

If 60 Gallons of Water do in a Hour fall into a Ciſtern holding 200 Gallons, and by a Pipe in the Ciſtern there runs out 45 Gallons in one Hour, in how many Hours will the Ciſtern be filled?

Firſt, Find how much more runs in, than runs out in one Hour, by ſubſtracting the one from the other, thus,

Runs in - 60
Runs out - 45
Difference - 15

Then ſay,
15 : 1 : : 200 : $13\frac{5}{15}$
200
15) 200 ($13\frac{5}{15}$ Anſwer.
15
50
45
Remains 5

Which is 13 Hours and 20 Minutes.

A Farmer ſends his Servant to Market with 216 *lib.* to buy Cattle, *viz.* Oxen at 11 *lib.* Cows at 8 *lib.* and Sheep at 3 *lib.* the Piece, and to bring Home alike Number of each, how many muſt he buy of each Sort.

Firſt add all the different Prices together, thus,

1 Ox - - 11
1 Cow - - 8
1 Sheep - 3
Total - - 22

Then ſay,
22 : 1 : : 216 : 9
22) 216 (9 Anſwer.
198
Remains 18 *lib.* of the Money.

So it appears that he muſt buy 9 of each Sort, and bring back 18 *lib.* of the Money,

Two Perſons *A.* and *B.* are to go one Journey; *A.* goes off 3 Days before *B.* and travels 30 Miles a Day; *B.* follows, and travels 50 Miles a Day: In how many Days, and after how many Miles travel will *B.* overtake *A.*

Firſt, Find how many Miles *B.* exceeds *A* in one Day. *Next*, Find how many Miles *A.* has travell'd before *B.* began his Journey, then ſtate your Queſtion as follows.

B. travels 50
A. travels 30
Difference 20

30 Miles *A*'s daily Travel.
3 Days before *B.*
90 Miles.

Then ſay,
20 : 1 :: 90 : $4\frac{1}{2}$
90
20) 90 ($4\frac{10}{20}$ or $\frac{1}{2}$ Days. Anſwer.
80
10

So it appears that *B.* will overtake *A.* in 4 Days and a Half. And travelling 50 Miles each Day makes 225 Miles.

Proof of the Rule of Three.

If the Queſtion be of the Direct Rule. Then multiply the 4th Number (or Anſwer of the Queſtion) by the firſt Number, and if the Product be equal to the Product of the ſecond and third Numbers multiplied together, your Work is right.

If your Queſtion be of the Indirect Rule. Then multiply the fourth Number (or Anſwer of the Queſtion) by the third Number, and if the Product be equal to the Product of the firſt and ſecond Numbers multiplied together, your Work is right.

But in Caſe theſe do not hold, you muſt do the Work over again to diſcover your Error.

Take the firſt two Examples thus,

Direct Rule.	Indirect Rule.
4 : 19 :: 8 : 38	8 : 12 :: 16 : 6
8	8
4) 152 (38 Anſwer.	16) 96 (6 Anſwer.
12 4	96 16
32 152 Proof.	0 36
32	6
0	96 Proof.

CHAP.

CHAP. XI.

The compound Rule of Three.

IT is alſo called *The double Rule of Three*; or, *The Rule of Three repeated*. In each Queſtion there are five Numbers given to find out a ſixth proportional thereto; which is commonly performed by two ſingle Operations of *The Rule of Three*, as the eaſieſt and plaineſt Way. Yet it may often be done another Way, as ſhall be ſhown afterwards, to ſatisfy the curious Learner.

In this Rule, as is ſaid, there are five Numbers given, to find out a ſixth Proportional. Of theſe five, the firſt three contain a Suppoſition, and in the other two a Queſtion is propounded. Thus,

If the Carriage of 20 Packs for 136 Miles coſt 16 *lib*. what will the Carriage of 12 Packs for 28 Miles coſt?

Theſe five Numbers are thus ranked,

Packs. Miles. *lib.* Packs. Miles. *lib.*
20 : 136 : 16 : : 12 : 28 : :

In which obſerve that the firſt and fourth are of one Denomination. Alſo the ſecond and fifth are of another Denomination. And the ſixth muſt be of the Denomination of the third.

When you are to make your Operation, your Numbers muſt be thus ranked,

Packs. *lib.* Packs.
20 : 16 : : 12
Miles. Miles.
136 : 28

In which obſerve, That the Term (or Number) which is of the ſame Denomination with the Term ſought, is in the Middle; The other two Terms of the

Suppoſition, are ſet in the firſt Place, the one above the other; and the two Terms upon which the Queſtion is made, are in the third Place, the one above the other alſo; In ſuch Manner, that the uppermoſt in the firſt and third Places are of one Denomination: And the two lower Numbers alſo of one Denomination.

These Rules are diligently to be obſerved in all Queſtions of the *Double Rule of Three.*

Now to work the foreſaid Queſtion,

Say firſt, 20 : 16 : : 12

```
          12
         ----
          32
         16
         ----
   20)   192 (9 lib. 12 ſh. Anſwer.
         180
         ----
          12
          20
         ----
   2|0)  24|0
         ----
          12 ſh.
```

Here the Anſwer in the firſt Operation is 9 *lib.* 12 *ſh.* Then ſay,

136 : 9 *lib.* 12 *ſh.* : : 28

```
          20
         ----
         192 ſh.
          28
         ----
        1536
        384
        -----
  136)  5376 ſh. (39 72/136 ſh.
          ..
        408
        ----
        1296
        1224
        ----
          72
```

which being reduced, makes 1 *lib.* 19 *ſh.* 6 *d.* and $\frac{6}{17}$ as the Anſwer.

So if 20 Packs carried 136 Miles coſt 16 *lib.* 12 Packs carried 28 Miles will coſt 1 *lib.* 19 *ſh.* 6 $\frac{6}{17}$ *d.*

Example 2. If 100 *lib.* in 12 Months give 6 *lib.* of Annualrent, how much Annualrent will 500 *lib* give in 8 Months, at the ſame Rate.

The State is thus,

100 : 6 : : 500
12 8

The firſt Operation is

100 : 6 : : 500
500
100) 30|00 (30 *lib.*

The ſecond Operation.

12 : 30 : : 8
8
12) 240 (20 *lib.* the Anſwer.
24
00

When you would work any Queſtion in the Double Rule of Three, by one compound Operation; you muſt take notice, That ſome Queſtions are Direct and ſome Indirect, as it is in the ſingle Rule already taught.

When the Queſtion is to be wrought by the *Compound Rule Direct*, obſerve this.

Rule. After your Numbers are ranked as formerly directed, multiply the two firſt Terms, the one by the other, and take their Product for the firſt Term; Take your middle Number for the ſecond Term; And the Product of the two laſt Terms multiplied, for the third Term; This done, work by the Rule of Three direct for a fourth Number, which is the Anſwer of your Queſtion.

Example. If 4 Students ſpend 19 *lib.* in 3 Months, how much will 8 Students ſpend in 9 Months.

See the Work.

	Stud.	*lib.*	*Stud.*	
Here 4 multiplied by 3 makes 12.	4 :	19 ::	8	Here 8 multiplied by 9 makes 72.
	Mo.		Mo.	
	3		9	
	12		72	

Then your Work will be as below.

12 : 19 :: 72
72
38
133
12) 1368 (114 *lib.* Anſwer.
12
16
12
48
48
0

When a compound Queſtion is propounded, if any of the ſingle Queſtions are to be reſolved by the Indirect Rule of Three; Then obſerve the following Directions.

Having ranked your Numbers as already directed; Multiply the higher Number in the third Place by the lower Number in the firſt Place, and take that Product for your firſt Term. Take the Middle Number for your ſecond Term. Then multiply the higher Number in the firſt Place by the lower Number in the third Place, and that Product is your third Term. Then conſider whether the Indirect Proportion lyes in the upper Line (or Queſtion) or in the lower: If it ly in the upper, then work the compound Operation by the Rule of Three Direct: But if the Indirect Proportion lie in the lower Line, then work by the Indirect Rule.

Example. If 9 Pecks of Corn ſerve 8 Horſes 12 Days, how long will 24 Pecks ſerve 16 Horſes?

See the Work.

Horſes. Days. Horſes.

Here 16 multiplied by 9 makes 144.	8 :	12 ::	16	Here 8 multiplied by 24 makes 192.
	Pecks.		Pecks.	
	9 :		24	
	144		192	

And the indirect Proportion lying in the upper Line, your compound Operation is as follows, by the Direct Rule.

144 : 12 :: 192
12
384
192
144) 2304 (16 Days. the Anſwer.
144
864
864
0

But in Caſe the foreſaid Queſtion be ſtated thus,

Pecks. Days. Pecks.
9 : 12 :: 24
Horſes. Horſes.
8 16

Then the indirect Proportion will be found in the lower Line, and the Operation will be as follows, by the Indirect Rule, for the Queſtion runs thus; If 9 Pecks of Corn are eaten in 12 Days by 8 Horſes, in how many Days will 24 Pecks be eaten by 16 Horſes.

See the Work.

```
   9 : 12 : : 24
   8 :        16
 -----      -----
   32         54
  16          9
 -----      -----
  192        144
   12
 -----
  384
 192
-----
144) 2304 (16
      ..
     144
    -----
     864
     864
    -----
       0
```

Days Anſwer, which is ſame as in the other Operation.

I have made all the Queſtions and Operations in the *Rule of Three*, whether Single or Compound, as plain and eaſy as poſſible; By which the attentive Learner may attain to a diſtinct Notion of this excellent Rule, and underſtand how to work any Queſtion that may be propounded, when he has duly conſidered the Nature thereof, and how the Numbers are to be ranked, and what previous Reductions or other Preparations are to be made according to the preceeding Rules.

CHAP. XII.

Of Fractions.

A *Fraction* is, one or more Parts of an *Integer* or *Unit*, according as the ſame is divided.

A *Fraction* is either *Proper* or *Improper*, *Single* or *Compound*.

A *Fraction* hath two Parts, *viz.* A *Numerator* and a *Denominator*, writ thus, $\frac{3}{4}$ $\begin{smallmatrix}\text{Numerator}\\ \text{Denominator}\end{smallmatrix}$. The Figure below the *Line* or *Denominator* ſhews how many Parts the Integer is divided into; the *Numerator* or Figure above the *Line* denotes how many of theſe Parts are contained in the *Fraction*, ſo $\frac{3}{4}$ is three Parts of four, or three fourth Parts of an Integer.

A *proper Fraction* is, when the *Numerator* is leſs than the *Denominator*, as $\frac{1}{2}$ $\frac{3}{4}$ $\frac{7}{8}$, &c.

An *improper Fraction* is, when the *Numerator* is greater than the *Denominator*, or equal to it, ſo ſuch *Fractions* are either greater than, or equal to an *Unit*. Thus $\frac{16}{4}$ of a *lib.* is 4 *lib.* alſo $\frac{4}{4}$ of a *lib.* is 1 *lib.* $\frac{17}{4}$ of a *lib.* is 4 *lib.* and $\frac{1}{4}$.

A *Single Fraction* is, when there is but one *Numerator*, and one *Denominator*, as, $\frac{3}{4}$ or $\frac{9}{2}$, &c.

A *Compound Fraction* is, a *Fraction* of a *Fraction*, or a *Part* or *Parts* of a *Fraction*, and hath ſeveral *Numerators* and *Denominators*, with the Word *of* interveening, as $\frac{1}{3}$ of $\frac{1}{2}$, or $\frac{1}{4}$ of $\frac{2}{3}$ of $\frac{1}{2}$.

In many Arithmetical Operations, there ariſes a *Mixt Number*, which conſiſts of an Unit or Units, with a Fraction adjoin'd, as $2\frac{1}{2}$, or $4\frac{3}{4}$, &c.

In the Doctrine of Fractions, the Rules of Reduction are firſt to be exactly taught; therefore let the Learner ſtudy the Rules following.

1. How to find the greateſt *common Meaſure* to any two Numbers, when they can be equally divided without

out leaving a Remainder in either. This is uſeful for the bringing great Fractions to their loweſt Terms, for making an Operation eaſy.

Rule. Divide the *Denominator* by the *Numerator*, then divide the Diviſor by the Remainder, and ſo go on dividing the Diviſor by the Remainder, until there be no Remainder, and the laſt Diviſor will be a common Diviſor to both the Numbers given.

Example. To find the greateſt common Diviſor to this Fraction $\frac{555}{629}$.

See the Work.

```
555) 629 (1
     555
   ---------
      74) 555 (7
          518
       ---------
          37) 74 (2
              74
             ----
              0
```

Here, firſt divide 629 by 555, there remains 74 by which divide 555, there remains 37; by which divide 74, there remains nothing, ſo 37 is the greateſt common Diviſor. Then divide 555 by 37, the Quotient will be 15, for a new Numerator; alſo divide 629 by 37, the Quotient will be 17, for a new Denominator. So $\frac{15}{17}$ is equal to $\frac{555}{269}$ and in much lower Terms.

But when a Fraction conſiſts of even Numbers, the Work of Reduction may be eaſier by halfing, as in this Example, $\frac{32}{128}$ may be reduced to $\frac{1}{4}$, after this Manner, $\frac{32}{128}$ one Half is $\frac{16}{64}$, one Half is $\frac{8}{32}$, one Half is $\frac{4}{16}$, one Half is $\frac{2}{8}$, one Half is $\frac{1}{4}$.

By this Rule, the attentive Learner may know how to reduce a Fraction by taking $\frac{1}{3}$, or $\frac{1}{4}$, or $\frac{1}{5}$, &c. of the Numerator and Denominator, as in this Example, $\frac{28}{84}$ one Quarter is $\frac{7}{21}$, on ſeventh is $\frac{1}{3}$.

When a Fraction ends with 5, or a Cypher, both in Numerator and Denominator, or with 5 in the one, and 0 in the other, ſuch Fractions may be reduced, by taking one Fifth, or one Tenth of both, as $\frac{235}{370}$, one Fifth whereof is $\frac{47}{74}$; and ſo $\frac{250}{240}$, one Tenth whereof is $\frac{15}{24}$, which again may be further reduced by taking one Third of each, which brings it to $\frac{5}{8}$.

2. To reduce an *improper Fraction*, to its Equivalent, Whole or Mixt Number.

Rule. Divide the Numerator by the Denominator, and the Quotient is the integral Parts.

So $\frac{8}{2}$ is 4 Integers; for 8 divided by 2, the Quotient is 4.

But if there be a Remainder after the Diviſion, that Remainder is a Numerator to the firſt Denominator, to be join'd to the Integers, which makes the Quotient a Mixt Number. So $\frac{35}{4}$ will be $8\frac{3}{4}$, for 35 divided by 4, the Quotient is 8, and 3 remaining, which ſet over 4 makes $\frac{3}{4}$.

3. To reduce a *whole Number* into an improper Fraction.

Rule. Set the whole Number as the Numerator, and 1 or an Unit as the Denominator; ſo 8 will be $\frac{8}{1}$, or 14 will be $\frac{14}{1}$.

4. To reduce a *Mixt Number* to an improper Fraction.

Rule. Multiply the Integers by the Denominator of the Fraction, and to the Product add the Numerator; and that Total Product is the Numerator to the Denominator. Thus $8\frac{3}{4}$ will be $\frac{35}{4}$; For 4 Times 8 is 32, to which adding the Numerator 3, makes the new Numerator 35.

5. To reduce *Fractions of ſeveral Denominations* into Fractions of like Value, but having one common Denominator.

Rule. Multiply the Numerator of each Fraction ſeparately into all the Denominators except its own, and the Product of each is a new Numerator: Then multiply all the Denominators into one another, and the Product thereof is the common Denominator to all the new Numerators.

$5\frac{5}{10}$ 45 $\frac{50}{10}$

Example. Reduce $\frac{2}{3}$ $\frac{3}{4}$ and $\frac{5}{7}$, to Fractions of one Denomination.

See the Work.

2. the 1. Numerator.
4. the 2. Denominator.
8. Product.
7. the 3. Denominator.
Total 56. the 1. new Numera.
3. the 2. Numerator.
3. the 1. Denominator.
9. Product.
7. the 3. Denominator.
Total 63. the 2. new Numera.
5. the 3. Numerator.
4. the 2. Denominator.
20. Product.
3. the 1. Denominator.
Total 60. the 3. new Numera.

Then for the Denominator.

3. the 1. Denominat.
4. the 2. Denominat.
12. Product.
7. the 3. Denominat.
84 Total new Denomin.

So the new Fractions will be theſe,

$$\left.\begin{matrix}\frac{56}{84}\\ \frac{63}{84}\\ \frac{60}{84}\end{matrix}\right\} \text{equal to} \left\{\begin{matrix}\frac{2}{3}\\ \frac{3}{4}\\ \frac{5}{7}\end{matrix}\right.$$

6. To reduce a *compound Fraction* to a *ſingle Fraction* of the ſame Value.

Rule. Multiply all the Numerators into one another, and take the Product for a new Numerator: Alſo multiply all the Denominators into one another, and take the Product for a new Denominator.

Example. Reduce $\frac{1}{8}$ of $\frac{2}{3}$ of $\frac{7}{8}$ into a ſimple Fraction.

See the Work.

1. the 1. Num.
2. the 2. Num.
2. Product.
7. the 3. Num.
14. Total Num.

8. the 1. Deno.
3. the 2. Deno.
24. Product.
8. the 3. Deno.
192. Total Deno.

So the Anſwer is $\frac{14}{192}$, which is equal to $\frac{1}{8}$ of $\frac{2}{3}$ of $\frac{7}{8}$.

7. To reduce a Fraction of a lower Denomination, to a Fraction of a higher Denomination.

Rule. Conſider how many Units of the Denomination of your Fraction, make an Unit of the next higher Denomination, and next how many of that make one Unit of the next ſuperior Denomination, and ſo on till you come to the higheſt you deſign, and ſet all down in the Form of a compound Fraction and then work as in the laſt Caſe.

Example. Reduce $\frac{2}{3}$ of a *d.* into the Fraction of a *lib.* Here, conſider that 12 *d.* make one *ſh.* ſo $\frac{2}{3}$ of a *d.* is $\frac{2}{3}$ of $\frac{1}{12}$ of a *ſh.* Next, conſider that 20 *ſh.* make 1 *lib.* therefore $\frac{2}{3}$ of a *d.* is $\frac{2}{3}$ of $\frac{1}{12}$ of $\frac{1}{20}$ of a *lib.* And by the Rule in the ſixth Caſe this compound Fraction will be reduced to $\frac{2}{720}$ of a *lib.* which is equal to $\frac{2}{3}$ of a *d.*

8. To reduce a Fraction of a higher Denomination, to a Fraction of a lower Denomination.

Rule. Multiply the Numerator by the Number of Units in the next inferior Denomination as make an Unit of the Denomination of your Fraction, and multiply that Product by the Number of Units in the next lower Denomination, as make an Unit of the laſt Denomination, and ſo on till you come to the loweſt, and take the laſt Product as a Numerator to your firſt Denominator.

Example. Reduce $\frac{3}{994}$ of a *lib.* to the Fraction of a *d.*

See the Work.

$$\begin{array}{r}3\\20\\\hline 60\\12\\\hline 120\ \text{ſh.}\\6\\\hline 720\ d.\end{array}$$

So the Fraction is $\frac{720}{994}$ of a *d.* which is equal to $\frac{3}{994}$ of a *lib.*

9. To diſcover *the Value* of any vulgar Fraction in the known Parts of the Integer.

Rule. Multiply the Numerator of your Fraction, by the Number of Units of the next inferior Denomination, that make an Unit of the Denomination of the Fraction, and divide that Product by the Denominator, and the Quotient is the Anſwer. And if there be any Remainder, you may find the *Value* thereof, by multiplying it by the Number of Units in the next lower Denomination, which make an Unit of the preceeding Denomination, and dividing the Product by the firſt Denominator, and ſo on till you come to the loweſt Denomination you can.

Example. What is the Value of $\frac{133}{480}$ of a *lib.*

See the Work.

```
                  133 the Numerator
      by - - -     20 ſh. in a lib.
Denominat. 48|0) 266|0 (5 ſh.
                 240
                  260 remains.
      by - - -     12 d. in a ſh.
                   52
                  26
           48|0) 312|0 (6 Pence
                 288
                  24 remains,
```

which is $\frac{24}{48}$ of a *d.* which reduced to its loweſt Terms is $\frac{1}{2}$ *d.* So the Value of $\frac{133}{480}$ of a *lib.* is 5 *ſh.* 6 $\frac{1}{2}$ *d.*

CHAP. XIII.

Addition of vulgar Fractions.

THE general Rule for Addition is, to reduce all the Fractions given into one Denomination, by the fifth Rule of Reduction; This being done, add all the new Numerators together, and take the Total for the Numerator, to the new common Denominator; Which is the Total of all the Fractions.

Example firſt, $\frac{1}{18}$ $\frac{3}{18}$ $\frac{5}{18}$ and $\frac{6}{18}$ to be added together will amount to $\frac{15}{18}$. For 1, 3, 5 and 6 being added, make 15, all the Denominators being already alike.

Example ſecond, Add $\frac{2}{5}$ $\frac{3}{7}$ and $\frac{1}{8}$ together.

Firſt, Reduce them to a common Denomination, ſo they will be $\frac{112}{324}$ $\frac{120}{324}$ and $\frac{35}{324}$. Then adding all the Numerators together, they amount to 267, ſo the Total is $\frac{267}{324}$.

To add mixt Numbers together.

Rule. Firſt, Add the Fractions according to the Rule above, then add the Integers, joining thereto the Amount of the Fractions, ſo you have the complete Total.

Example. $4\frac{5}{6}$ and $5\frac{7}{8}$ to be added.

Firſt, Add $\frac{5}{6}$ and $\frac{7}{8}$ they make $1\frac{32}{48}$ which added to 4 and 5, makes $10\frac{32}{48}$ or $10\frac{2}{3}$.

To add compound Fractions.

Rule. Reduce your compound Fractions to ſimple Fractions, then add theſe together according to the preceeding Rules.

Example. $\frac{1}{3}$ of $\frac{1}{2}$, and $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{3}{4}$ to be added together.

Firſt, Your compound Fractions being reduced to ſimple Fractions, will be $\frac{1}{6}$ and $\frac{6}{24}$; which being brought to one Denomination, will be $\frac{24}{144}$ $\frac{36}{144}$, then adding the Numerators together, makes the Total $\frac{60}{144}$ or $\frac{3}{4}$.

CHAP. XIV.

Subſtraction in vulgar Fractions.

AS in Addition the Fractions given were reduced to one Denomination, ſo muſt they be in Subſtraction, and that Reduction being made, ſubſtract the Numerator of the leſſer Fraction from the Numerator of the greater, and the Remainder is the Anſwer.

Example. Subſtract $\frac{3}{8}$ from $\frac{5}{8}$, remains $\frac{2}{8}$

In Subſtraction there are three Caſes wherein Reduction muſt be uſed before we proceed to the Work of Subſtraction.

1. When the Fractions given are of different Denominations, they muſt be reduced to one Denomination.

Example. Subſtract $\frac{2}{3}$ from $\frac{7}{9}$. Having reduced theſe to one Denomination, they will be $\frac{18}{27}$ and $\frac{21}{27}$. Then ſubſtracting the leſſer Numerator from the greater, the Remainder is the Anſwer. So here 18 ſubſtracted from 21, remains 3, which is $\frac{3}{27}$ or $\frac{1}{9}$.

But when the Fractions given are of one Denomination, the Work is done by ſimple Subſtraction of the leſſer Numerator from the greater, as above.

Example. Subſtract $\frac{2}{5}$ from $\frac{4}{5}$, remains $\frac{2}{5}$.

2. When one of the Fractions is a compound Fraction: The compound muſt be reduced to a ſimple Fraction.

Example. Subſtract $\frac{1}{2}$ of $\frac{1}{3}$ from $\frac{7}{8}$; Here the compound Fraction being reduced is $\frac{1}{6}$. Then reducing this $\frac{1}{6}$, and the other Fraction $\frac{7}{8}$ into one Denomination, will be $\frac{8}{48}$ $\frac{42}{48}$, laſtly ſubſtracting the leſſer Numerator from the greater, the Remainder will be $\frac{34}{48}$ or $\frac{17}{24}$.

3. When whole or mixt Numbers occur, as a Fraction to be ſubſtracted from a whole or mixt Number; Or a mixt Number to be ſubſtracted from a mixt Number; or laſtly, a whole Number to be ſubſtracted from a mixt Number.

The general Rule is, Reduce the whole or mixt Numbers to improper Fractions; then reduce theſe to one Denomination, and laſtly, ſubſtract the leſſer from the greater, ſo you have the Anſwer.

Example. What is the Difference betwixt $4\frac{1}{3}$ and $2\frac{2}{3}$. Theſe reduced to improper Fractions are $\frac{13}{3}$ and $\frac{8}{3}$. Which being of one Denomination, the Difference is $\frac{5}{3}$ or $1\frac{2}{3}$.

Another Example. What is the Difference betwixt 8 and $3\frac{1}{4}$. Theſe reduced will be $\frac{8}{1}$ and $\frac{13}{4}$; which brought to one Denomination will be $\frac{32}{4}$ $\frac{13}{4}$; And the leſſer ſubſtracted from the greater, there remains $\frac{19}{4}$ or $4\frac{3}{4}$.

Example. 3. What is the Difference betwixt $7\frac{1}{2}$ and 4. Theſe reduced will be $\frac{15}{2}$ and $\frac{4}{1}$, which brought to one Denomination are $\frac{15}{2}$ $\frac{8}{2}$, and the leſſer ſubſtracted from the greater, there remains $\frac{7}{2}$ or $3\frac{1}{2}$.

But the Work of Subſtraction when mixt or whole Numbers occur may be oft contracted, as in the Examples following.

Subſtract $3\frac{1}{2}$ from 9. Here ſubſtract $\frac{1}{2}$ from 1 Integer there remains $\frac{1}{2}$, then ſubſtract 3 out of 8 (the firſt 9 being leſſen'd by 1) there remains 5, ſo the whole Remains join'd is $5\frac{1}{2}$

Subſtract 4 from $7\frac{1}{4}$. Here ſubſtract 4 from 7, there remains 3, to which add the Fraction join'd to 7, makes $3\frac{1}{4}$ for the Remainder.

Subſtract $9\frac{1}{4}$ from $15\frac{3}{4}$. Here ſubſtract $\frac{1}{4}$ from $\frac{3}{4}$, there remains $\frac{2}{4}$ or $\frac{1}{2}$, then ſubſtract 9 from 15, there remains 6. So the two Remainders being join'd make $6\frac{3}{4}$ in all.

Subſtract $14\frac{2}{3}$ from $19\frac{1}{3}$. Here becauſe the Fraction of the leſſer Number, is greater than the Fraction of the greater Number, therefore you muſt reduce an Unit of the greater Number, with its Fraction, into an improper Fraction, and then the Numbers will ſtand thus, $18\frac{4}{3}$ and $14\frac{2}{3}$, then ſubſtract as in the laſt Example, and the Remainder will be $4\frac{2}{3}$, thus, $\frac{2}{3}$ from $\frac{4}{3}$, remains $\frac{2}{3}$, and 14 from 18, there remains 4.

CHAP. XV.

Multiplication in vulgar Fractions.

IN this Rule there is no need to reduce ſimple Fractions to one Denomination, as in the two preceeding Rules. *But* if a compound Fraction be given, it muſt be reduced to a ſimple; *Alſo* if mixt Numbers or whole Numbers be given, theſe muſt be reduced to improper Fractions; Then work by this

Rule. Multiply the Numerators into one another, and take the Product for a new Numerator; Alſo multiply the Denominators into one another, and take the Product for a new Denominator; which two make the Product ſought.

Example, 1ſt. Multiply $\frac{2}{3}$ by $\frac{3}{5}$. They make $\frac{6}{15}$, or $\frac{2}{5}$.

Example 2d. Multiply $\frac{4}{7}$ by $\frac{1}{4}$ of $\frac{2}{3}$. Here the compound Fraction being reduced makes $\frac{2}{12}$, which multiplied by $\frac{4}{7}$, makes $\frac{8}{84}$ or $\frac{2}{21}$.

Example 3d. Multiply 7 by $\frac{3}{5}$. Here the whole Number being brought to an improper Fraction is $\frac{7}{1}$, which multiplied by $\frac{3}{5}$ makes $\frac{21}{5}$, or $4\frac{1}{5}$.

Example 4th. Multiply $23\frac{3}{4}$ by $19\frac{5}{6}$. Here both Numbers being breduc'd to improper Fractions, will be $\frac{95}{4}$ and $\frac{119}{6}$, which multiplied together, will be $\frac{11305}{24}$, which is $471\frac{1}{24}$.

CHAP.

CHAP. XVI.

Diviſion in vulgar Fractions.

IN this Rule, as in Multiplication, there is no need to reduce ſimple Fractions to one Denomination. But if a compound Fraction be given, it muſt be reduced to a ſimple Fraction. Alſo if mixt Numbers or a whole Number be given, theſe muſt be reduc'd to improper Fractions. Then work by this

Rule, Multiply the Numerator of the Dividend, by the Denominator of the Diviſor, and take the Product for the Numerator of the Quotient. Alſo multiply the Denominator of the Dividend by the Numerator of the Diviſor, and the Product is the Denominator of the Quotient.

Example *Firſt*, Divide $\frac{11}{12}$ by $\frac{1}{2}$. Place your Diviſor and Dividend as in whole Numbers; Then work by the Direction given. Thus,

$\frac{1}{2}$) $\frac{11}{12}$ ($\frac{22}{12}$ Anſwer. Which is 1 $\frac{5}{6}$.

Example *Second*, Divide $\frac{7}{8}$ by $\frac{1}{3}$ of $\frac{1}{5}$. Here the compound Fraction being reduced is [illegible] or $\frac{1}{15}$; Then the Work ſtands thus, $\frac{1}{15}$) $\frac{7}{8}$ ($\frac{105}{8}$ Anſwer, which is 13 $\frac{1}{8}$.

Example *Third*, Divide 5 $\frac{3}{7}$ by 2 $\frac{3}{5}$. Here both Numbers being reduc'd to improper Fractions, will be $\frac{38}{7}$ by $\frac{13}{5}$. Then the Work ſtanks thus,

$\frac{13}{5}$) $\frac{38}{7}$ ($\frac{190}{91}$, which is 2 $\frac{8}{91}$.

Example *Fourth*, Divide 7 by $\frac{2}{5}$. Here 7 muſt be brought to an improper Fraction. Then the Work ſtands thus,

$\frac{2}{5}$) $\frac{7}{1}$ ($\frac{35}{2}$, which is 17 $\frac{1}{2}$.

Having now explain'd the Doctrine of Vulgar Fractions in all its Parts; And the Golden Rule, both Single and Compound, being fully treated of in whole Numbers, it is needleſs to repeat that Rule in Fractions, the ſame being alike both in whole Numbers and Fractions as to Method; Only when a Queſtion of the Rule of Three falls to be in Fractions, the preceeding Rules for Fractional Operations are to be obſerved.

CHAP. XVII.

Decimal Arithmetick.

A Decimal Fraction always ſuppoſes the Integer to be divided into 10, 100, or 1000, or 10000 Parts, *&c.* to what Degree you pleaſe for Exactneſs: Hence the Denominator is always known, and needs not be writ; but you place and uſe your Fraction as an Integer, taking Care only to prefix the *Decimal Point*, for diſtinguiſhing it from an Integer, ſo $\frac{5}{10}$ is writ thus .5; and $\frac{27}{100}$ is writ .27; and $\frac{149}{1000}$ is writ .149: In which obſerve, That as many Figures as there are in the Numerator, ſo many Cyphers there are in the Denominator with an Unit prefixt in Place of the *Point* in the Numerator.

When a Decimal Fraction has not ſo many Figures in the Numerator as there are Cyphers in the Denominator, the void Places are filled up with Cyphers on the left Hand, ſo $\frac{5}{100}$ is writ thus .05; alſo $\frac{3}{1000}$ is writ thus .003, *&c.* Whence it appears, that as in whole Numbers Cyphers on the right Hand, *increaſe* the Number or Value, ſo in Decimals, Cyphers on the left Hand, *diminiſh* the Value, as in the following Table.

Integers.	5	is		Five
	50			Fifty
	500			Five hundred
	5000			Five thouſand.
Decimals.	.5	is	$\frac{5}{10}$	Five, tenth Parts.
	.05		$\frac{5}{100}$	Five, hundredth Parts.
	.005		$\frac{5}{1000}$	Five, thouſand Parts.
	.0005		$\frac{5}{10000}$	Five, ten thouſand Parts.

So, as in whole Numbers, the Value increaſeth from the *right Hand* to the *Left*. In Decimals, the Value decreaſeth from the *left Hand* to the *Right*; as in the Table below.

Millions.	Hundreds of thouſands.	Tens of thouſands.	Thouſands.	Hundreds.	Tens.	Units.
7	6	5	4	3	2	1.

Integers.

Tenth Parts.	Hundred Parts.	Thouſand Parts.	Ten thouſand Parts.	Hundred thouſand Parts.	Million Parts.	Ten Million Parts.
.2	3	4	5	6	7	8

Decimals.

Obſerve alſo, That as in whole Numbers Cyphers on the *left Hand*, neither *increaſe* nor *diminiſh* the Value: So in Decimals, Cyphers on the *right Hand*, neither *increaſe* nor *diminiſh* the Value. Thus 025 in whole Numbers is no better than 25. And in Decimals .500 is no better than .5.

What a Decimal is, being now explain'd, the firſt Rule, for Operation, to be taught is Reduction.

CHAP. XVIII.

Reduction in Decimals.

HERE 'tis proper to remark that in reducing vulgar Fractions to Decimals: The Decimal will not always, be of full Value with the Vulgar; but yet it may be brought ſo near, by increaſing the Number of Places, that the Defect needs not be regarded, as will hereafter appear; and for the greateſt in ordinary Practice 5 or 6 Places is ſufficient; though in calculating Tables more Places are needful.

Now in reducing a vulgar Fraction to a Decimal, the Proportion is this; As the Denominator of the Fraction given is to its Numerator, ſo is 10, 100, 1000, 10000, *&c.* to the Decimal whoſe Denominator is 10, 100, 1000, or 10000, *&c.*

Suppoſe then $\frac{1}{8}$ given to be reduced to a Decimal; The State of the Queſtion will be this, by the Rule of Three.

8 : 1 :: 1000
1000

8) 1000 (.125 Anſwer.
...
8

20
16

40
40

0

So this Decimal .125 is exactly equal to the Fraction $\frac{1}{8}$.

Example 2. Reduce $\frac{5}{7}$ to a Decimal.

See the Work.

7 : 5 : : 10000 (
10000
7) 50000 (.7142, Anſwer.
. . . .
49
10
7
30
28
20
14
6 Remains.

Here, tho there be 6, remaining in the Diviſion, yet it is ſo ſmall that it does not amount to the thouſand Part of an Unit.

You may take the Rule for Reduction plainly thus. Add a competent Number of Cyphers to the Numerator of the Fraction given, then divide by the Denominator, and the Quotient is the Anſwer. But take Care to place the Decimal Point before the Cyphers which you add, becauſe ſo many Cyphers as are added in the Work, ſo many Places muſt there be in the Quotient or Anſwer; And if ſo many do not ariſe (as often there will not) you muſt ſupply the Defect by prefixing Cyphers on the left Hand, as in this Example 3d.

Reduce $\frac{3}{35}$ to a Decimal.

See the Work.

35) 3.0000 (.0857 Anſwer.
. . .
280
200
175
250
245
5

Here after finiſhing the Diviſion there are but three Figures in the Quotient, and there being four Cyphers added in the Work, the Defect is made up by prefixing a Cypher, which makes the Quotient .0857.

Example 4. Reduce 14 *ſh.* to the Decimal of a *lib.* Here, conſider that 14 *ſh.* is $\frac{14}{20}$ of a *lib.* So the Operation is thus,

```
20) 14.0 (.7 Anſwer.
    140
    ———
      0
```

Example 5. Reduce 13 *ſh.* to a Decimal. The Work is thus,

```
20) 13.00 (.65 Anſwer.
       · ·
    120
    ———
     100
     100
     ———
       0
```

Example 6. Reduce 3 *d.* to the Decimal of a *lib.*

Here you muſt conſider, that there being 240 *d.* in a *lib.* ſo 3 *d.* is $\frac{3}{240}$ of a *lib.* and therefore the Work is as follows.

```
24|0) 3.000|0 (.0125 Anſwer.
        · · ·
        24
        ——
         60
         48
         ——
          120
          120
          ———
            0
```

Obſerv

Obſerve that when a compound Fraction is given to be reduc'd into a Decimal, it muſt firſt be reduc'd to a ſimple Fraction, and that ſimple muſt be reduc'd to a decimal Fraction.

Example 7. Reduce $\frac{1}{3}$ of $\frac{3}{4}$ to a Decimal, Firſt, This being reduc'd to a Simple is $\frac{3}{12}$, which reduc'd to a Decimal is .25. The Learner may make the Operation.

To find the Value of a decimal Fraction, obſerve this

Rule. Multiply the Decimal given by ſuch a Number of Units of the next inferior Denomination, as make an Unit of your decimal Denomination, and cut off as many Figures on the right Hand of the Product, as there are Places in the Decimal, and the Figures cut off on the left Hand, are ſo many Integers of that inferior Denomination: And go on repeating the like Work, till you have no Remainder, or have found the Units of the loweſt Denomination you deſire.

Example. What is the Value of .6125 of a *lib.*

See the Work.

.6125
20
ſh. 12|25|00
12
50
25
d. 3|00

So the Anſwer is 12 *ſh.* 3 *d.*

Example 2. What is the Amount of .7354 of a Year.

See the Work.

.7354
Months in a Year - 12
14708
7354
Months 8|8248
Weeks in a Month - 4
Weeks 3|2992
Days in a Week - 7
Days 2|0944
Hours in a Day - 24
3776
1888
Hours 2|2656
Minutes in an Hour 60
Minutes 15|9360

The whole is 8 Months, 3 Weeks, 2 Days, 2 Hours, 15 Minutes, and very near a Minute more.

What is the Amount of .3567 of a Chalder of Victual.

.3567
Bolls in a Chalder 16
21402
3567
Bolls - - - 5|7072
4
Firlots - - 2|8288
4
Pecks - - - 3|3152
4
Lippies - - 1|2608

The whole is 5 Bolls 2 Firlots, 3 Pecks, 1 Lippie, and the Fraction of a Lippie.

The Value of the Decimal of a *lib.* or 20 *ſh.* may be known by Inſpection, without any Operation by this

Rule. Double the Figure ſtanding next to the Decimal Point, and if the Figure in the ſecond Place be 5 or more, add one to the former Product, which together is ſo many *ſh.* Then the Figure remaining in the ſecond Place, and the Figure in the third Place make ſo many Fourth Parts of a *d.* therefore taking a Fourth Part thereof you have the *d.* of the Decimal: With this Caution, That if the Number amount to 13, and within in 39, you muſt deduct 1, and if it be 39, or above; you muſt deduct 2 before you take your Pence.

Example, .75 is 15 *ſh.* for 2 Times 7 is 14, to which adding 1, for 5, ſtanding in the ſecond Place, makes 15.

Alſo, .465 is 9 *ſh.* 3 *d.* for twice 4 is 8, to which adding 1, becauſe the ſecond Figure exceeds 5, makes 9 *ſh.* Then there remains 15 in the ſecond and third Places, which made leſs by 1, remains 14, which divided by 4 produces 3 *d.* and a Fraction remaining, which needs not be regarded, ſeeing in *Scotland* we uſe no Denomination below a Penny, and there is never leſs than 2 *d.* paid or received.

What has been already ſaid, is ſufficient to give the ingenious Learner the right Notion of Decimals; therefore I proceed to the Rules of Addition, Subſtraction, Multiplication and Diviſion.

CHAP. XIX.

Addition of Decimals.

THERE is no Difference betwixt this and Addition of whole Numbers; but Care muſt be taken to place the Decimals orderly, that is, the Decimal Points all directly under one another, and the Figures of each Place in their due Order; And in the Total after Addition, you muſt Point off ſo many Figures on the right Hand, as there are Places in the greateſt Decimal of the Work.

Notice alſo, That in Mixt Numbers, the Integers ſtand on the left Hand of the Decimal Point, thus, 25.25, which is 25 *lib.* 5 *ſh.*

Examples.

.9654	.245	22.0732	10.5763
.835	.31	12.0095	9.005
.75	.152	11.163	8.075
.006	.35	10.999	7.1463
.074	.427	6.854	6.0532
2.6304	1.484	63.0987	40.8558

CHAP. XX.

Subſtraction in Decimals.

TAKE Care only to ſet down your Numbers right as directed in Addition, and then work as in Subſtraction of whole Numbers.

Examples.

From -	39.725	11.32	.986	2.357
Subſtract	18.012	9.2954	.095	1.989
Remains	21.713	2.0246	.891	.368

CHAP.

CHAP. XXI.

Multiplication in Decimals.

IN this there is no Difference from Multiplication in whole Numbers; Except that after your Multiplication is ended, you are to obſerve this general *Rule*, To point off, towards the right Hand, ſo many Figures of the Product, as there are Decimals both in the Multiplicand and Multiplier, and if ſo many happen not to be in the Product (as it will happen when you multiply two Fractions of little Value, or a ſmall mixt Number by a ſmall Fraction) you muſt make up the Number by annexing Cyphers on the left Hand, and then prefix the Decimal Point.

Example 1.

Multiply - - 3.467
by - - 19.01
3467
31203
3467
Product - 65.90767

Example 2.

Multiply - - .13461
by - - 42
26922
53844
Product - 5.65362

Example 3.

Multiply - - 36492
by - - .032
72984
109476
Product - - 1167.744

Example 4.

Multiply - - .1264
by- - - .247
8848
5056
2528
Product - .0312208

In this 4th Example you ſee a Cypher added to make up the Decimals in the Product.

Example 5.

Multiply - - .01832
by - - - - .007

Product - .00012824

In this Example three Cyphers are added to the Product, both Fractions being ſmall, and ſo producing a very ſmall Product, as is remarked in the Rule above for Multiplication.

Example 6.

Multiply - - - 2.0051
by - - - - .0004

Product - - .00080204

In this Exmple three Cyphers are added to the Product, the Mixt Number being ſmall, and multiplied by a ſmall Fraction.

CHAP. XXII.

Diviſion in Decimals.

IN this Rule you muſt place your Numbers and work as in Diviſion of Integers: All the Difficulty being to diſcover the true Value of the Quotient, for which End obſerve this

Rule, Notice how many Decimal Places there are in the Diviſor, and how many in the Dividend; And ſo many as theſe in the Dividend exceed thoſe in the Diviſor, point off as many to the right Hand in the Quotient, And if there be not as many in the Quotient, make up the Deficiency by prefixing Cyphers on the left Hand.

Obſerve alſo this Rule, That if in the Numbers given, there be no Decimals in the Dividend, or fewer than in the Diviſor, you muſt add ſo many Cyphers on the right Hand of your Dividend, as will make the

Decimals therein exceed thoſe in the Diviſor, and for ordinary 3, 4 or 5 Cyphers will be enough.

The following Examples will make all this very plain.

1 Example. Divide 742.651 amongſt 41 Perſons.

See the Work.

```
41) 742.651 (18.113, Anſwer.
     . . . . .
    41
    ---
    332
    328
    ---
      46
      41
      --
       55
       41
       --
       141
       123
       ---
Remains 18
```

In this Quotient there are 3 Decimals pointed off equal to the Decimals in the Dividend, there being none in the Diviſor. So the Anſwer is 18 *lib.* 2 *ſh.* 3 *d.* to each, and a very inconſiderable Fraction over.

2 Example. Divide 4672.565 by 25.635.

```
25.635) 4672.565000 (182.272 Anſwer.
              . . . . .
        25635
        ------
        210906
        205080
        ------
          58265
          51270
          ------
           69950
           51270
           ------
           186800
           179445
           ------
             73550
             51270
             ------
Remains - -  22280
```

In this Example, becauſe the Decimals in both Numbers were equal, three Cyphers are added to the Dividend, and conſequently three Figures are pointed off in the Quotient, which makes the Anſwer to be 182.272 and a ſmall Remainder which is leſs than one thouſand Part of an Integer.

3 Example. Divide 1425 by .6252.

.6252) 1425.000000 (2279.27. Anſwer.
· · · · · ·
12504
17460
12504
49560
43764
57960
56268
16920
12504
44160
43764
396

In this Example, becauſe there are four Decimals in the Diviſor, and none in the Dividend, therefore there are ſix Cyphers added to the Dividend, which is two more than in the Diviſor, and conſequently two Figures are cut off in the Quotient.

Nota, That all Cyphers added to the Dividend, ſtand only as Decimals.

4. Example. Divide .13975, by 43.

43) .13975 (.00325, Anſwer.
· · ·
129
107
86
215
215
0

In this, after the Diviſion is finiſhed, there are but three Figures in the Quotient, and ſeeing there ought to be five, the Deficiency is ſupplied by annexing two Cyphers on the left Hand.

5 Example. Divide .75 by .0125.

```
.0125) .7500 (60, Anſwer.
        .750
        ----
          00
```

In this Example obſerve, That by adding two Cyphers to the Dividend, the Number of Places both in Diviſor and Dividend are equal, and therefore none to be pointed off in the Quotient: So the Anſwer is 60 Integers.

6 Example. Divide 32.457 by 8756.323.

```
8756.323) 32.457000000 (.003706
                 ....
          26268969
          --------
          61880310
          61294261
          --------
            58604900
            52537938
            --------
             6066962
```

In this ſixth Example, the Number of Decimals being equal both in Diviſor and Dividend, and the Diviſor conſiſting of many Integers, there is a Neceſſity to add ſix Cyphers to the Dividend, by which the Decimals in the Dividend exceed thoſe in the Diviſor, by ſix, and there ariſing only four Figures in the Quotient, the other two are ſupplied by prefixing two Cyphers.

When any Decimal Fraction or mixt Number is to be divided by an Article, that is, a Number conſiſting of an Unit and a Cypher or Cyphers, as 10, 100, 1000 *&c.*

Rule. Remove the Decimal Point ſo many Places towards the left Hand, as there are Cyphers annexed to the Unit, and when there occur blank Places, fill them up with Cyphers.

Example. Suppoſe 17.28, given to be divided by

	10	The Quotient will be	1.728
or by	100		.1728
or by	1000		.01728
or by	10000		.001728

Hence it follows, That if the Diviſor be an Article above Unity with Cyphers, as 20, 300, 4000, the Diviſion is performed by removing the Decimal Point according to the preceeding Rule, and then taking the Half, Third, Fourth, *&c.* Part of the Number. Thus,

423.576 divided by 200, the Operation is thus;

$$\frac{1}{2} \text{ is } - - \frac{4.23576}{2.11788} \text{ for Anſwer.}$$

376.4596 divided by 40, the Operation is thus,

$$\frac{1}{4} \text{ is } - \frac{37.64596}{9.41149} \text{ for Anſwer.}$$

5687.22 divided by 6000, the Operation is thus,

$$\frac{1}{6} \text{ is } - - \frac{5.68722}{.94787} \text{ for Anſwer.}$$

42.33 divided by 300, the Operation is thus,

$$\frac{1}{3} \text{ is } - \frac{.4233}{.1411} \text{ Anſwer.}$$

I ſhall conclude this ſmall Treatiſe with one Remark, *viz.* That the Iſſue of the Work of Multiplication and Diviſion in Fractions, whether Vulgar or Decimal, differs from that in whole Numbers: For in whole Numbers the Product of Multiplication is always greater, both in Value and Number, than the Multiplicand, becauſe it is the multiplying of Units, which muſt neceſſarly augment them. Whereas in Fractions the Product of Multiplication is always leſs in Value, though it may be greater in Number, than the Multiplicand;

becauſe it is the Multiplication of the Parts into which an Unit is divided, which muſt needs make the Parts produced leſs in Value, tho greater in Number.

The Reaſon of this is, That if a Fraction be multiplied by 1 or Unity, it produceth the Fraction given: But if a Fraction be multiplied by $\frac{1}{2}$, the Product muſt be the half of the Fraction given; ſo $\frac{3}{4}$ multiplied by $\frac{2}{3}$, the Product muſt be $\frac{2}{3}$ of $\frac{3}{4}$ which is $\frac{6}{12}$ or $\frac{1}{2}$, which is leſs than the Multiplicand.

And Diviſion being the Reverſe of Multiplication; Therefore, as in whole Numbers the Quotient is leſs than the Dividend; ſo in Diviſion of Fractions, the Quotient is greater than the Dividend, and often ariſes to Integers. All which is plainly illuſtrated in the preceeding Rules and Examples.

The Golden Rule in Decimals is the ſame with that in whole Numbers, obſerving only the Rules for decimal Operation, as before taught.

APPENDIX.

ALTHO' there are excellent Tables of *Intereſt*, both ſimple and compound, to be found in ſeveral Books of *Arithmetick* lately publiſhed; yet none of them ſerving for *Scotland*, becauſe of the Variation of the Rate of *Intereſt*, by Acts of Parliament from Time to Time, therefore the following Tables 'tis hop'd will be acceptable, the ſame being adapted for *Scots* Uſe.

The *Firſt Table* ſhews the Intereſt of 100 *lib.* from *Martinmaſs* 1669, to any Term thereafter, which may be continued and filled up from Term to Term, after the Rate of Intereſt is eſtabliſhed by Law. This Table hath four *Columns*; The 1. For the Years of GOD, in which is noted the Day of the Month on which *Whit-*

ſunday did yearly fall, marked *M.* for *May*, or *J.* for *June*, until the ſame was fixed to the 15th *May* by Act of Parliament, *Anno* 1690. The 2. *Column* contains the four ordinary Quarters, marked thus, *C.* for *Candlemaſs*, *W.* for *Whitſunday*, *L.* for *Lambmaſs*, *M.* for *Martinmaſs*. The 3. contains the *Rate* of *Intereſt* termly. The 4. contains the aggregated Intereſt as the ſame increaſes quarterly.

The *Second Table* ſhews, The Intereſt of 100 *lib.* for any Number of Days not exceeding 30, and which ſerves for any greater Number of Days, as ſhall be ſhown in the Directions for the Uſe of the Tables.

The Uſe of theſe Tables will be beſt cleared by Examples. As to the 1. Table, *Quæritur*, What is the Intereſt of 100 *lib.* from *Martinmaſs* 1669, to *Lambmaſs* 1705? Look in the Table for the Year 1705, and over-againſt *L.* for *Lambmaſs* you'll find 206.75, which is the Anſwer. *Example* 2. What is the Intereſt of 100 *lib.* from *Whitſunday* 1690 to *Martinmaſs* 1715? Look in the Table for the Year 1715, and over-againſt *M.* for *Martinmaſs*, you'll find 262.75; next look for the Year 1690, and over-againſt *W.* for *Whitſunday* you'll find 122 *lib.* which ſubſtracted from 262.75 *lib.* there remains 140.75, which is the Anſwer.

Examples of the *Second Table*. What is the Intereſt of 100 *lib.* for 28 Days, at 5½ *per Cent.* Look in the Table on the *Column* bearing 5½ *per Cent.* on the Head, and over-againſt 28 in the *Column* of Days, you'll find .421917, which is the Anſwer. *Example* 2, What is the Intereſt of 100 *lib.* for 19 Days, at 6 *per Cent.* In the Table on the *Column* under 6 *per Cent.* at the Head, over-againſt 1 Day, you'll find .016438, but becauſe you want for 10 Days, move the Decimal Point one Step or Figure to the right Hand, and you have .16438. Then in the ſaid *Column* over-againſt 9 Days, you'll find .147945: Theſe two being added together make .312325 which is the Anſwer. *Example* 3. What is the Intereſt of 100 *lib.* for 285 Days at 5 *per Cent.* In the Table on the *Column* under 5 at the Head, over-againſt 2 in the *Column* of Days, you'll find .027397, but becauſe you want for 200 Days, move the Decimal Point 2 Steps or Figures to the right Hand, and you have 2.7397. Next in the ſame *Column* over againſt 8 Days, you'll find .109589, and becauſe you want for 8 Days, move the Decimal Point one Step to the right Hand, and you have 1.09589. Laſtly in the ſame *Column*, over againſt 5 Days, you'll find .068493, then add 2.7397, 1.09589 and .068493 together, makes 3.904083, which is the Anſwer.

Having by any of the Tables found the Intereſt of 100 for the Time you deſire, the Intereſt of any other Sum is eaſily found by the common Rule of multiplying the Number found by the Table, by the Sum propoſed, and dividing the Product by 100, or cutting off two Figures, which is the ſame; as has been taught in the Rules of Multiplication and Diviſion. *Example* 1. Having found by the firſt Table that the Intereſt of 100 *lib.* from *VVhitſunday* 1700, to *VVhitſunday* 1720, is 107.5 and ſuppoſing the Sum whereof you want the Intereſt for the ſame Period of Time to be 1245 *lib.* multiply the Number found in the Table by 1245, the Product will be 133837.5, which divided by 100, produces 1338.375 for your Anſwer. *Example* 2. Having found by the 2. Table, that the Intereſt of 100 *lib.* for 85 Days at 6 *per Cent.* is 1.39719, and ſuppoſe the Sum, whereof you want the Intereſt for the like Number of Days, to be 357 *lib.* Multiply the Number found in the Table by 357, makes 498.79683 which divided by 100, produces 4.9879683 for your Anſwer.

A TABLE *of* INTEREST *of* L. 100 *from* Martinmaſs 1669, *to the ſeveral Terms following, at the ſeveral Rates according to Law, to be continued termly.*

Year.	Term.	Rate.	Intereſt.	Year.	Term.	Rate.	Intereſt
1670	*C.*	6	1.5	1675	*C.*	6	30.5
M. 22.	*W.*	6	3.	*M.* 23.	*W.*	6	32.
	L.	6	4.5		*L.*	6	33.5
	M.	6	6.		*M.*	6	35.
1671	*C.*	6	7.5	1676	*C.*	6	36.5
J. 11.	*W.*	6	9.	*M.* 14.	*W.*	6	38.
	L.	6	10.5		*L.*	6	39.5
	M.	6	12.		*M.*	6	41.
1672	*C.*	6	13.5	1677	*C.*	6	42.5
M. 20.	*W.*	6	15.	*J.* 3.	*W.*	6	44.
	L.	6	16.5		*L.*	6	45.5
	M.	6	18.		*M.*	6	47.
1673	*C.*	5	19.25	1678	*C.*	6	48.5
M. 18.	*W.*	5	20.5	*M.* 19.	*W.*	6	50.
	L.	5	21.75		*L.*	6	51.5
	M.	5	23.		*M.*	6	53.
1674	*C.*	6	24.5	1679	*C.*	6	54.5
J. 7.	*W.*	6	26.	*J.* 8.	*W.*	6	56.
	L.	6	27.5		*L.*	6	57.5
	M.	6	29.		*M.*	6	59.

Year.	Term.	Rate.	Intereſt.
1680	*C.*	6	60.5
M. 30.	*W.*	6	62.
	L.	6	63.5
	M.	6	65.
1681	*C.*	6	66.5
M. 22.	*W.*	6	68.
	L.	6	69.5
	M.	6	71.
1682	*C.*	6	72.5
J. 4.	*W*	6	74.
	L.	6	75.5
	M.	6	77.
1683	*C.*	6	78.5
M. 27.	*W.*	6	80.
	L.	6	81.5
	M.	6	83.
1684	*C*	6	84.5
M. 18.	*W.*	6	86.
	L.	6	87.5
	M.	6	89.
1685	*C.*	6	90.5
J. 7.	*W.*	6	92.
	L.	6	93.5
	M.	6	95.
1686	*C.*	6	96.5
M. 23.	*W.*	6	98.
	L.	6	99.5
	M.	6	101.
1687	*C.*	6	102.5
M. 15.	*W.*	6	104.
	L.	6	105.5
	M.	6	107.
1688	*C.*	6	108.5
J. 3.	*W.*	6	110.
	L.	6	111.5
	M.	6	113.
1689	*C.*	6	114.5
M. 19.	*W.*	6	116.
	L.	6	117.5
	M	6	119.
1690	*C.*	6	120.5
M. 15.	*W*	6	122.
fixed by	*L.*	5	123.25
A. of P.	*M.*	5	124.5
1691	*C.*	5	125.75
	W	5	127.
	L.	6	128.5
	M.	6	130.
1692	*C.*	6	131.5
	W.	6	133.
	L.	6	134.5
	M.	6	136.
1693	*C.*	6	137.5
	W	6	139.
	L.	6	140.5
	M.	6	142.
1694	*C.*	6	143.5
	W.	6	145.
	L.	6	146.5
	M.	6	148.
1695	*C.*	6	149.5
	W.	6	151.
	L.	5	152.25
	M.	5	153.5
1696	*C.*	5	154.75
	W.	5	156.
	L.	6	157.5
	M.	6	159.
1697	*C.*	5	160.25
	W.	5	161.5
	L.	5	162.75
	M.	5	164.

Year.	Term.	Rate.	Intereſt.
1698	*C.*	5	165.25
	W.	5	166.5
	L.	6	168.
	M.	6	169.5
1699	*C.*	5½	170.875
	W.	5½	172.25
	L.	5½	173.625
	M.	5½	175.
1700	*C.*	5½	176.375
	W.	5½	177.75
	L.	5½	179.125
	M.	5½	180.5
1701	*C.*	5½	181.875
	W.	5½	183.25
	L.	5½	184.625
	M.	5½	186.
1702	*C.*	5½	187.375
	W.	5½	188.75
	L.	5½	190.125
	M.	5½	191.5
1703	*C.*	5½	192.875
	W.	5½	194.25
	L.	5½	195.625
	M.	5½	197.
1704	*C.*	5½	198.375
	W.	5½	199.75
	L.	5½	201.125
	M.	5½	202.5
1705	*C.*	5½	203.875
	W.	5½	205.25
	L.	6	206.75
	M.	6	208.25
1706	*C.*	5½	209.625
	W.	5½	211.
	L.	5½	212.375
	M.	5½	213.75
1707	*C.*	5½	215.125
	W.	5½	216.5
	L.	5½	217.875
	M.	5½	219.25
1708	*C.*	5½	220.625
	W.	5½	222.
	L.	5½	223.375
	M.	5½	224.75
1709	*C.*	5½	226.125
	W.	5½	227.5
	L.	5½	228.875
	M.	5½	230.25
1710	*C.*	5½	231.625
	W.	5½	233.
	L.	5½	234.375
	M.	5½	235.75
1711	*C.*	5½	237.125
	W.	5½	238.5
	L.	5½	239.875
	M.	5½	241 25
1712	*C.*	5½	242.625
	W.	5½	244.
	L.	5½	245.375
	M.	5½	246.75
1713	*C.*	5½	248.125
	W.	5½	249.5
	L.	5½	250.875
	M.	5½	252.25
1714	*C.*	5½	253.625
	W.	5½	255.
	L.	5½	256.375
	M.	5½	257.75
1715	*C.*	5	259.
	W.	5	260.25
	L.	5	261.5
	M.	5	262.75

Year.	Term.	Rate.	Interest.	Year.	Term.	Rate.	Interest.
1716	*C.*	5	264.	1725	*C.*		
	W.	5	265.25		*W.*		
	L.	5	266.5		*L.*		
	M.	5	267.75		*M.*		
1717	*C.*	5	269.	1726	*C.*		
	W.	5	270.25		*W.*		
	L.	5	271.5		*L.*		
	M.	5	272.75		*M.*		
1718	*C.*	5	274.	1727	*C.*		
	W.	5	275.25		*W.*		
	L.	5	276.5		*L.*		
	M.	5	277.75		*M.*		
1719	*C.*	5	279.	1728	*C.*		
	W.	5	280.25		*W.*		
	L.	5	281.5		*L.*		
	M.	5	282.75		*M.*		
1720	*C.*	5	284.	1729	*C.*		
	W.	5	285.25		*W.*		
	L.	5	286.5		*L.*		
	M.	5	287.75		*M.*		
1721	*C.*	5	289.	1730	*C.*		
	W.	5	290.25		*W.*		
	L.				*L.*		
	M.				*M.*		
1722	*C.*			1731	*C.*		
	W.				*W.*		
	L.				*L.*		
	M.				*M.*		
1723	*C.*			1732	*C.*		
	W.				*W.*		
	L.				*L.*		
	M.				*M.*		
1724	*C.*			1733	*C.*		
	W.				*W.*		
	L.				*L.*		
	M.				*M.*		

A TABLE *ſhewing the* INTEREST *of* L. 100 *for any Number of Days, at any of the Rates following.*

Days	At 6 per Cent.	At $5\frac{1}{2}$ per Cent.	At 5 per Cent.	At $4\frac{1}{2}$ per Cent.	At 4 per Cent.
1	.016438	.015068	.013698	.012328	.010958
2	.032876	.030136	.027397	.024657	.021917
3	.049315	.045205	.041095	.036986	.032876
4	.065753	.060273	.054794	.049315	.043835
5	.082191	.075342	.068493	.061643	.054794
6	.098630	.090410	.082191	.073972	.065753
7	.115068	.105479	.095890	.086301	.076712
8	.131506	.120547	.109589	.098630	.087671
9	147945	.135616	.123287	.110958	.098630
10	.164383	.150684	.136986	.123287	.109589
11	.180821	.165753	.150684	.135616	.120547
12	.197260	.180821	.164383	.147945	.131506
13	.213698	.195890	.178082	.160273	.142465
14	.230136	.210958	.191780	.172602	.153424
15	.246575	.226027	.205479	.184931	.164383
16	.263013	.241095	.219178	.197260	.175342
17	.279451	.256164	.232876	.209588	.186301
18	.295890	.271232	.246575	.221917	.197260
19	.312328	.286301	.260273	.234246	.208219
20	.328767	.301369	.273972	.246575	.219178
21	.345205	.316438	.287671	.258903	.230136
22	.361643	.331506	.301369	.271232	.241095
23	.378082	.346575	.315068	.283561	.252054
24	.394520	.361643	.328767	.295890	.263013
25	.410958	.376712	.342465	.308219	.273972
2[illegible]	.427397	.391780	.356164	.320547	.284931
27	.443835	.406849	.369863	.332876	.295890
28	.460273	.421917	.383561	.345205	.306849
29	.476712	.436986	.397260	.357534	.317808
30	.493150	.452054	.410958	.369862	.328767

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